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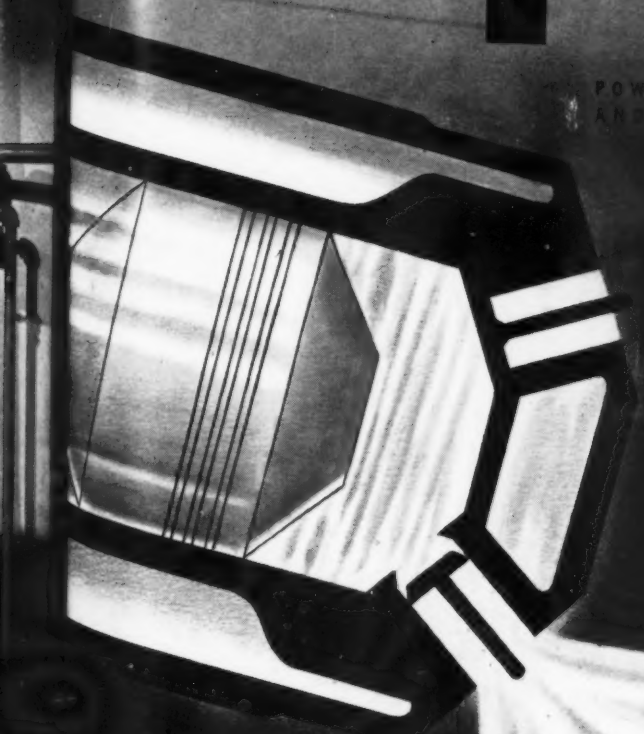
POWER

POWER GENERATION, TRANSMISSION AND ITS APPLICATION

APRIL, 1943

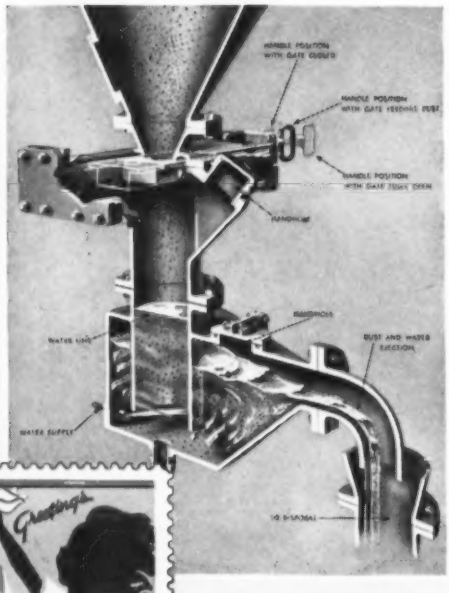


In this issue—COMPRESSED AIR for WAR PRODUCTION

THE *Grass Can't Grow on a Busy Street* PRINCIPLE

APPLIED TO DUST REMOVAL

Do YOU have Trouble with Coking in Dust Hoppers?



F YOU have trouble removing dust from hoppers beneath the Last Boiler Pass or the Economizer, due to coking or baking of dust into lumps, between dust removal periods, investigate the Hydro-Mix Valve. It eliminates the necessity of breaking up hard lumps with a rod (a nasty time-consuming task at any time, especially under peak load conditions) because LUMPS CANNOT FORM. Reason—the DUST IS REMOVED CONTINUOUSLY. As grass does not grow on a busy street, so lumps do not form in a hopper, if there is no storage period to give it an opportunity to bake or coke. . . . The illustration at the left shows the operation of a Hydro-Mix Valve. Dust continuously passes from the hopper, mixes with the water in the valve (Hydro-Mix) and overflows into the discharge piping. It may then flow by gravity or be pumped, to lowlands for fill. Catalogs on Hydro-Mix Valves and Hydroseal Ash Pumps sent on request.

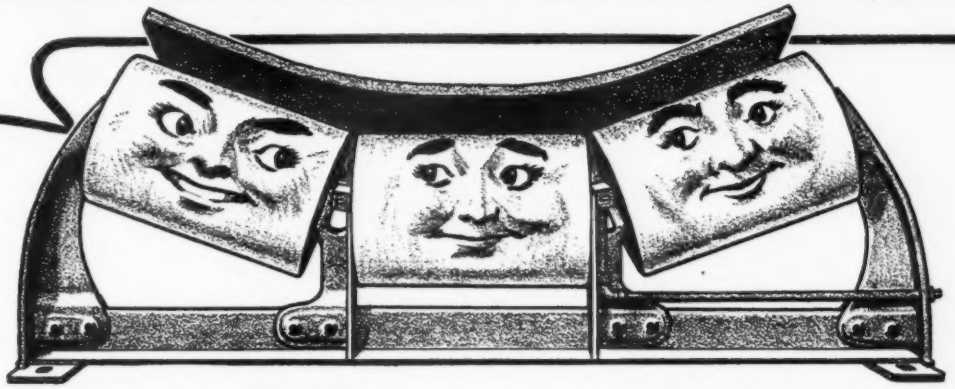
HYDRO-MIX VALVES

BUY EASTER SEALS

ALLEN-SHERMAN-HOFF CO., 227 S. 15th St., PHILADELPHIA • *Offices & Representatives in Principal Ci*

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"). April, 1943, Vol. 87, No. 4. Published monthly with an extra Directory number in December. McGraw-Hill Publishing Company, Inc., Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive offices, 330 West 42nd Street, New York. Entered as second-class matter August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communic about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries, $6.00 for one year, $9.00 for two years, 35c per copy.

BROTHER, BE WISE—PROLONG THE LIFE OF CONVEYOR BELTS AND BELT CONVEYOR EQUIPMENT!



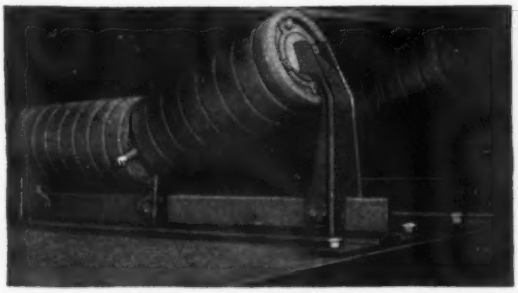
If "we" could only talk—here's what we'd say: "Operators, please give us extra special care to make us last longer. This is mighty important during wartime, because materials used in belt conveyor equipment are needed for guns, tanks, planes and other war uipment. Be wise—be patriotic—follow this advice—it will pay extra dividends in tro. .ee operation."

1

KEEP INSTALLATION CLEAN. Cleanliness plays an important part in prolonging the life of your belt conveyor equipment. Make a daily inspection to see that there is no accumulation of material that has spilled off the belt. If material is not removed it will cause the belt to drag over it as well as around the head, tail, snub and other pulleys. Consideration should also be given to cleaning the belt. The material being handled determines the type of cleaning device.

2

TRAIN THE BELT AND MAINTAIN THE TRAINING WITH SELF-ALIGNING IDLERS. It is important that both the carrying and return runs of a conveyor belt be kept practically central with its supporting idlers. This can be accomplished by properly "training" the belt on the conveyor . . maintaining that training is assured through the use of self-aligning idlers and return rolls. Link-Belt manufactures a complete line of self-aligning idlers to meet every need.



3

USE IMPACT IDLERS AT LOADING AND TRANSFER POINTS. When tons of ore, rock, coal and other materials slap a belt on the back, proper protection must be given at the loading point. The use of Link-Belt Rubber-Tread Impact Idlers definitely prolongs belt life by preventing cutting and bruising of belt . . cushioning even the heaviest blows . . thus greatly increasing belt life and protecting the belt, idler bearings and framework. Link-Belt engineers will be glad to make recommendations.

4

MAINTAIN PROPER BELT TENSION AND LUBRICATION. Eliminate excessive belt sag between idler rolls—Proper tension relieves the belt of much unnecessary wear . . Never over-lubricate idler rolls—inspection of one idler roll will often determine at what intervals equipment should be lubricated. Too much grease is as bad as too little.

AND MAKE IT A RULE to establish regular inspection periods—and make replacements with genuine Link-Belt parts when necessary. Link-Belt manufactures a complete line of idlers, pulleys, bearings, take-ups, drives, trippers, etc.

LINK-BELT
BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY

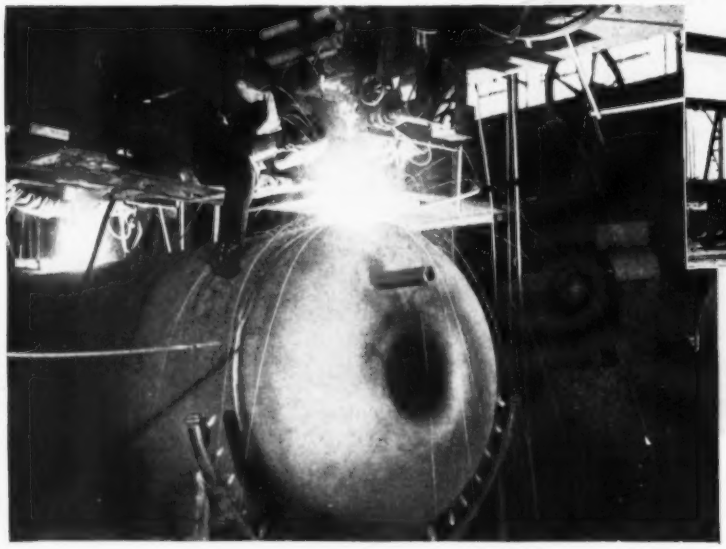
Indianapolis, Chicago, Philadelphia, Atlanta, Dallas, San Francisco, New York, Toronto. Offices, warehouses and distributors in principal cities. 9067

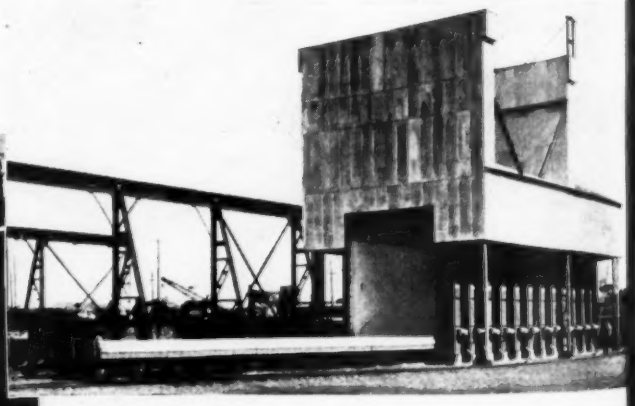
Science Aids B&W

MANUFACTURING METHODS on Process Equipment

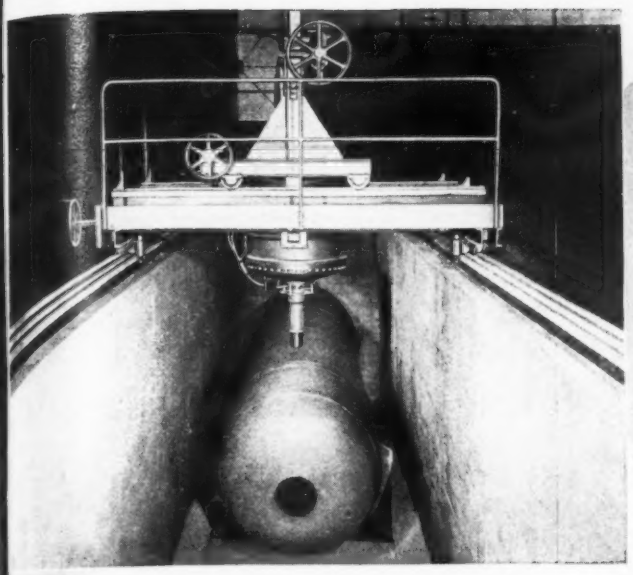
Three modern and scientifically sound operations help build dependability with speed into Babcock & Wilcox high-temperature, high-pressure process equipment.

WELDING: All longitudinal and circumferential joints are welded by automatic welding machines, other connections are welded manually to drums and shells.





STRESS-RELIEVING: After the welded joints have been tested by the X-Ray, and all parts welded to the drum, the drum is stress-relieved by the B&W heat-treating process. The structure is brought up to the specific temperature slowly, at a rate dependent on the wall thickness and the form of the vessel. This entire operation conforms to the A.S.M.E. Boiler Code.



X-RAY INSPECTION: As additional guarantee of soundness, every inch of main welds is explored with powerful X-Ray equipment. This examination definitely locates *ANY* defect, shows it clearly, and provides a permanent record of each welded job.

Monster elbow connection and header produced by the exclusive B&W forging method. Drum is 66 inches in diameter, tapering to 17-inch opening. The forged elbow tapers from 30 inches in diameter on one end, to 25 inches on the other. Steel plate, four inches thick is used throughout.

Each of these three steps plays a major role in the efficient manufacturing technique that B&W engineers have developed to save time and steel—important factors in the March to Victory. Ask The Babcock & Wilcox Co. to help meet your need for modern process equipment.

S-36T

Maritime Victory flag and "M" burgee float proudly alongside the Navy "E" at Barberton Works. Each is an award of outstanding achievement and is "an honor lightly bestowed".

BABCOCK & WILCOX

VESSELS. DRUMS. CASTINGS. FORGINGS

FOR HIGH-TEMPERATURE, FOR HIGH-PRESSURE SERVICE

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., NEW YORK, N. Y.

Why they call

Typical group of strainers tagged and ready to go to the shipping room. All of these are Twin Strainers. Some are for oil lines, and some (shown in background) are large units for water service. In the immediate foreground, a high-pressure strainer as used on fuel oil discharge, and at its right, a strainer for low-pressure suction service. Notice the chain drive which operates both gate valves simultaneously, shifting the flow from one cylinder to the other.

ELLIOTT

ELLIOTT

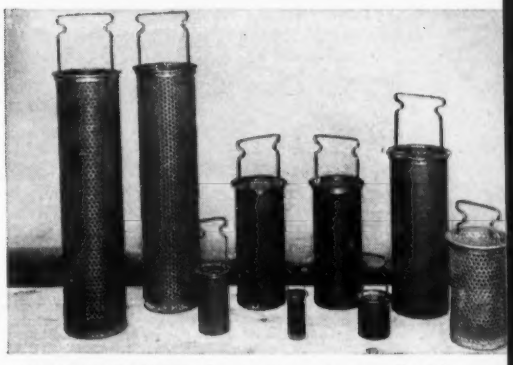
"STRAINER HEADQUARTERS"

You might think that the business of straining liquids is small-time stuff. You would be wrong.

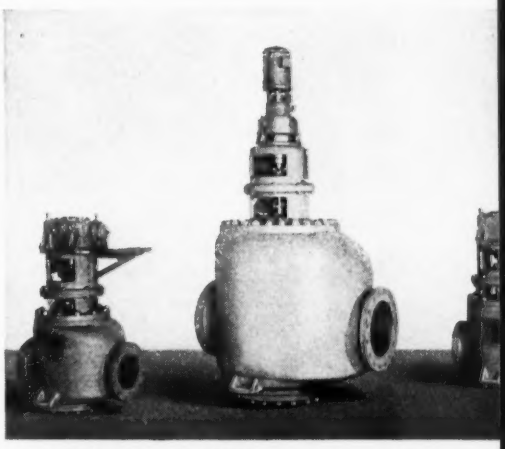
Carload after carload of Elliott strainers are getting into this war. They're going aboard tankers, warships, cargo vessels—straining oil and water. They're going into process plants getting out war materials in the making of which clear liquids are essential. And they're going into the power plants that keep the wheels of production turning.

The mere volume of straining units leaving the Elliott plant is impressive, and alone justifies the term "Strainer Headquarters." But behind that are many years during which Elliott has specialized in these trouble-saving units, designing and developing new types, and advising as to their application, meeting all kinds of unusual problems, straining everything from cold molasses to alcohol. This broad experience is yours to command. Bring your straining problem to "Strainer Headquarters."

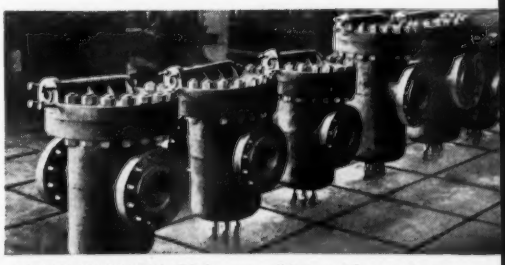
Elliott strainers come in three general types—Single Strainers, where temporary shutdown for cleaning is permissible . . . Twin Strainers, in which the alternate cylinder takes the load while one is being cleaned . . . and Self-Cleaning Strainers which as the name implies, clear themselves without attention, for non-stop service. For details on any of these, write us.



STRAINER BASKETS for any service or liquid. Above are a few of those available, showing the variety of meshes.



SELF-CLEANING STRAINERS, small and large. Driven by motor, which can be mounted vertically or horizontally. Used principally in clearing water of volumes of dirt or other foreign matter.



DESUPERHEATERS TOO — ranking with strainers as an Elliott specialty. They remove the superheat from steam where required. In oil tankers, for instance, steam for main propulsion equipment is heated above the flash point of some petroleum products. Elliott desuperheaters reduce this temperature, insuring safety. Widely used in power plants and in process work.

Army-Navy "E" pennant awarded to both Jeannette and Ridgway plants of Elliott Company.

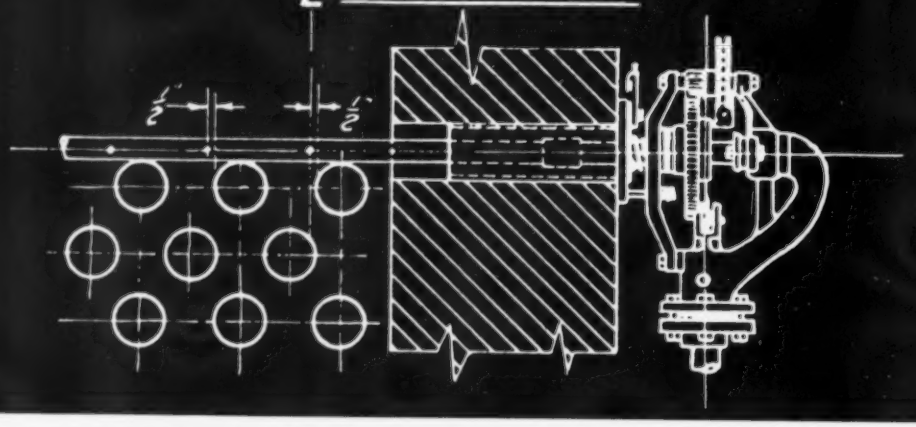
A-281

COMPANY

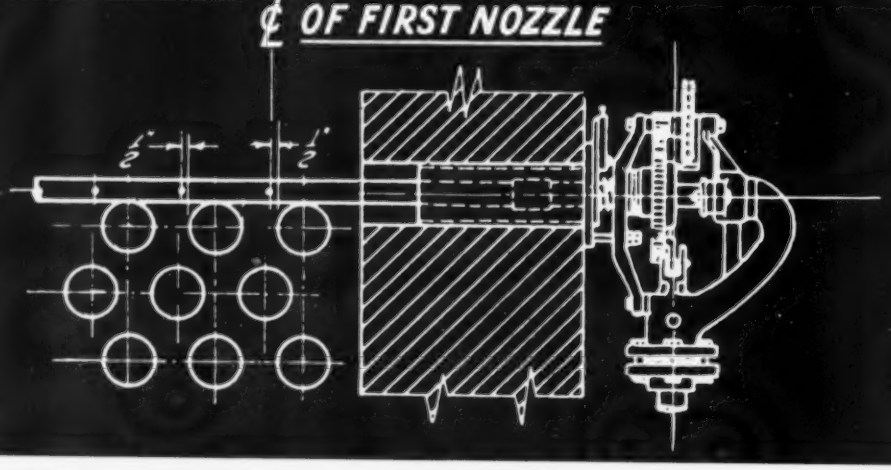
Accessories Department, **JEANNETTE, PA.**

DISTRICT OFFICES IN PRINCIPAL CITIES

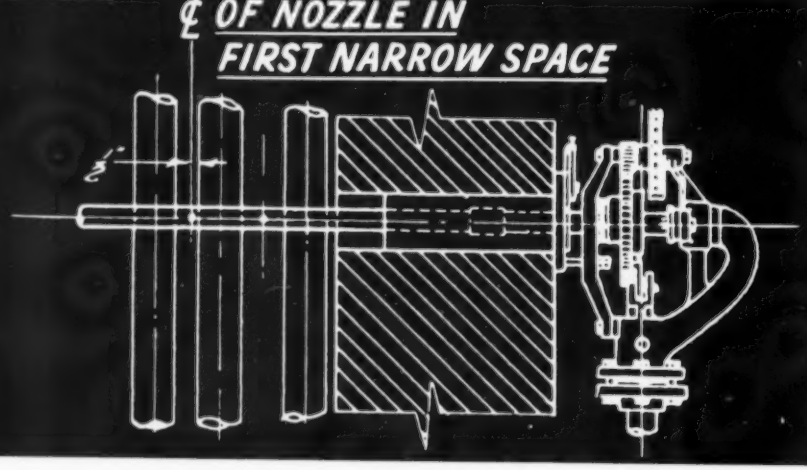
GET MORE out of the SOOT BLOWERS you have



EVENLY STAGGERED TUBES



UNEVENLY STAGGERED TUBES



UNEVENLY SPACED TUBES

CORRECT NOZZLE SETTING IS NECESSARY TO EFFICIENT BLOWING

Correct setting of nozzles is necessary to efficient boiler cleaning—removal of soot with minimum expenditure of steam.

Each time a boiler is taken out of service, all soot blower elements should be checked for correct nozzle setting. Scoring of tubes usually indicates impingement of steam jets—the nozzles are positioned too close to some of the tubes.

Correct setting is a simple matter. Elements should be adjusted so that the first nozzle is ½-inch away from the far side of the tube nearest the head. Measurements are taken, of course, from the tube row nearest the element.

If it is necessary to move the element ½-inch or less in order to properly line up the nozzles with the tubes, the head can easily be moved in or out by adjusting the nuts on the bracket stud or adjustment sleeve stud. If larger adjustment is necessary, this may be made by cutting off the swivel tube or by putting in a longer one, as the situation requires.

THROW YOUR *Scrap* INTO THE FIGHT

URGENT WAR NEEDS *DEMAND* LONGER BLOWER LIFE

Diamond, in common with many other firms, is meeting heavy war demands. It is not always possible for us to supply new blowers or repair parts as quickly as you need them.

Careful maintenance and repair will prolong the life of the soot blowers you have—defer the time when new blowers or repair parts are needed.

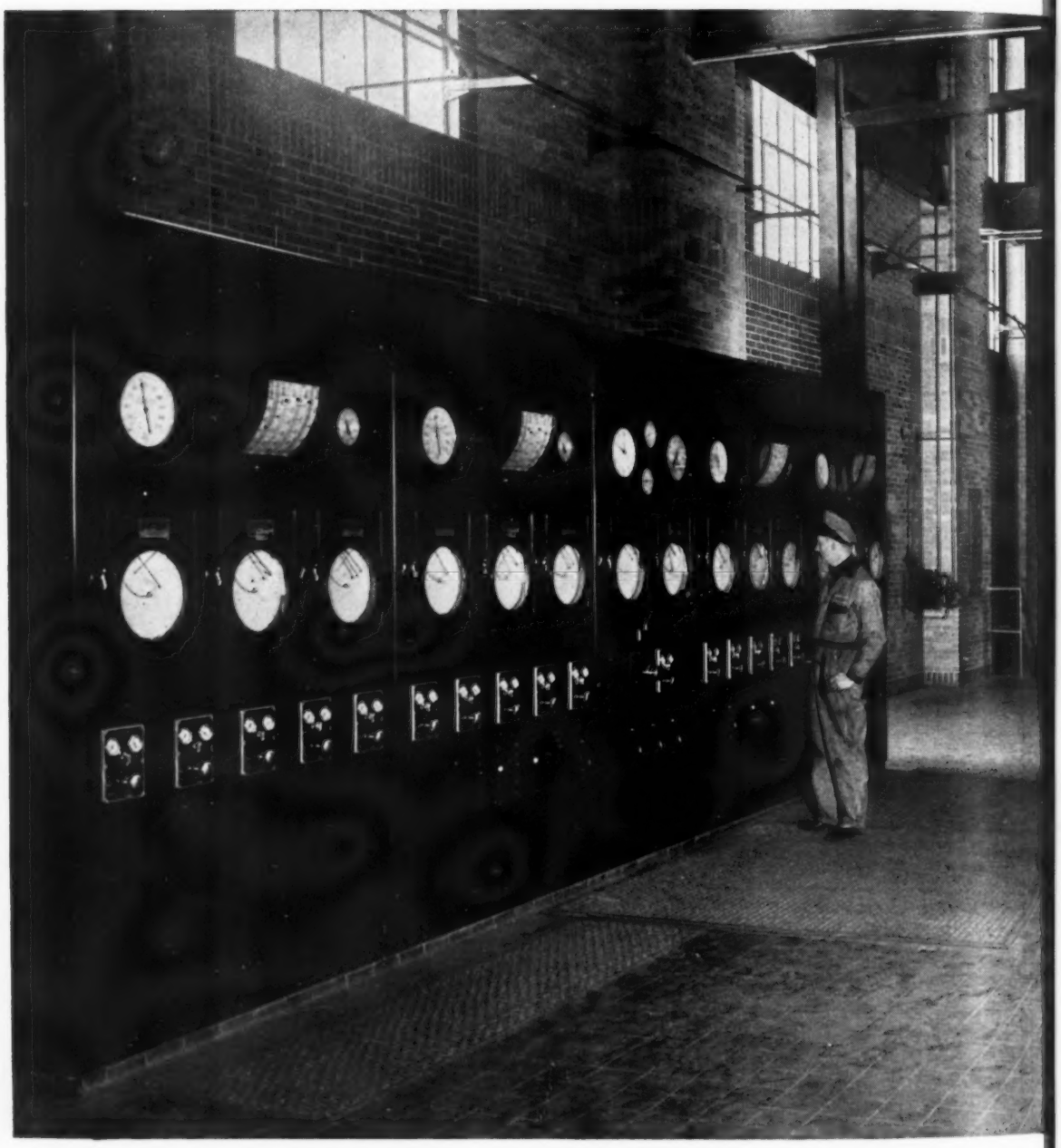
This booklet has been prepared for the purpose of helping you do this. Write for a copy.

DIAMOND POWER SPECIALTY CORP.
Detroit, Michigan

DIAMOND SPECIALTY LIMITED, Windsor, Ontario

Boiler Control eases

Continuity of Operation, Fuel
Can Be Maintained While



BAILEY METERS

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

Manpower Shortage

Economy and Maximum Safety Training New Operators

★ Power Engineers are now faced with the difficult task of operating at full capacity and high efficiency in spite of a serious lack of experienced manpower. Under these conditions complete boiler control is the power engineer's best friend and most trusted lieutenant. It stays on the job continuously and is a valuable aid in carrying on normal operation while new manpower is being "broken in".

It maintains continuity of operation, fuel economy, and maximum safety equally well with experienced or inexperienced operators.

Bailey Boiler Control is a truly complete system. In addition to the usual functions of maintaining steam pressure, regulating furnace draft, and distributing load among boilers, it offers these additional values:

1. An automatic readjustment of the fuel—air ratio which functions continuously to insure economical combustion and safe furnace temperatures day after day.

2. No control system is better than its metering device—in the Bailey System, control impulses are originated by standard Bailey Meters.

3. Provision is made for the protection of steam generating equipment by the addition of purge interlocks, fan failure interlocks and flame detectors.

A helpful discussion on the use of boiler control for war time power plant operation is contained in Bulletin No. 16, "How To Safely Stretch Steaming Capacity." A copy will be mailed to you upon request.

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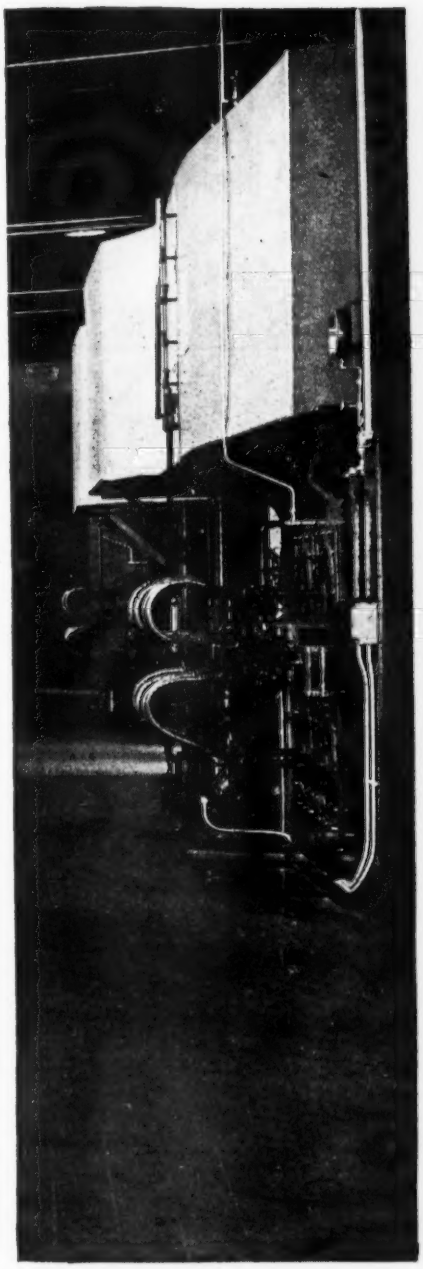


BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND, OHIO

Bailey Meter Company Limited, Montreal, Canada

. . . The Complete Boiler Control System

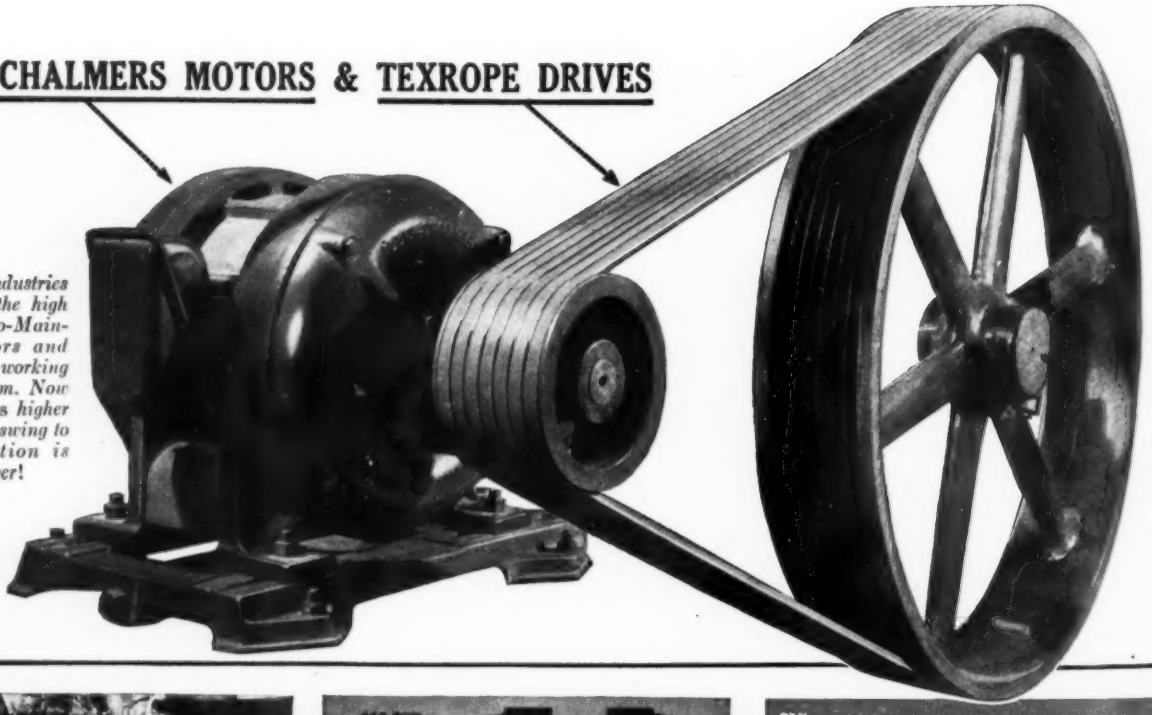
CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

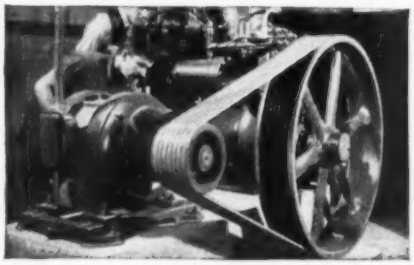
IN PEACE AND WAR--

Give this an "E" for

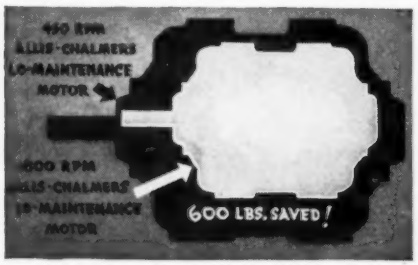
ALLIS-CHALMERS MOTORS & TEXROPE DRIVES

Thousands of industries already know the high efficiency of Lo-Maintenance Motors and Texrope Drives working together as a team. Now that war forces higher efficiencies, the swing to this combination is stronger than ever!

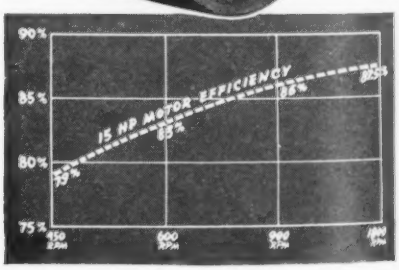




1 In most applications, an 1800 rpm motor with Texrope Drive will ably do the job of a lower-speed, direct-connected motor —at lower cost in money *and materials!*



2 When you buy an 1800 rpm instead of 450 rpm 15 hp squirrel-cage motor, for example, 600 lb are saved. And *you* save well over $200 — with drive figured in!



3 Note that efficiency rises from 79% for the 450 rpm motor to 87.5% for the 1800 rpm motor. The 1800 rpm motor saves you over 30 kw/24 hr. day.

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ALLIS-

Combination Efficiency!

☛ Using high-speed motors with Allis-Chalmers Texrope Drives and single-speed motors with Allis-Chalmers Vari-Pitch Sheaves and Speed Changers has always been good practice. Today it's a vital practice!

☛ Such combinations give sharply higher efficiencies —at lower cost in man-hours, money and materials!

☛ As America's only builder of both motors and V-belt drives, Allis-Chalmers has long studied and advocated their use in proper combination.

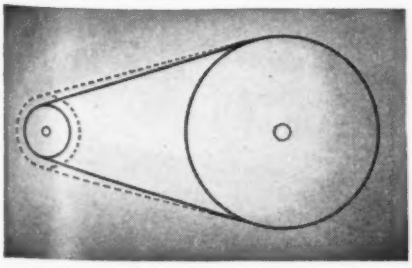
☛ Today you benefit from Allis-Chalmers pioneering when you ask for—and get—the right combination of Lo-Maintenance Motor and Texrope Drive!

BUILDING the largest variety of capital goods in the world, Allis-Chalmers know-how is in many ways unique — and is *completely* at the service of American war industry.

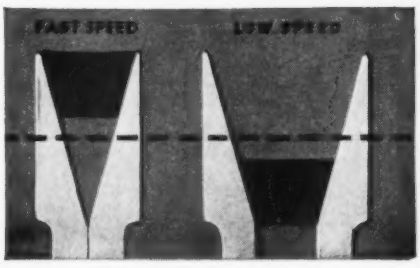
Allis-Chalmers, builder of Lo-Maintenance Motors, *originated* the multiple V-belt drive and Vari-Pitch Sheaves.

Today there's every patriotic *and business* reason for using material-saving, money-saving single speed and high-speed motors — made flexible and more efficient by Texrope Drives.

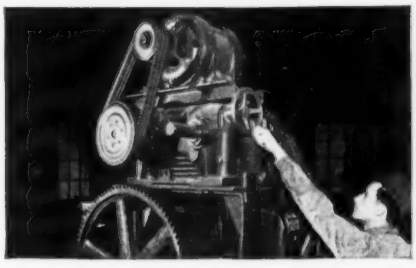
Don't hesitate to call on Allis-Chalmers district offices for engineering data or recommendations — or write direct to ALLIS-CHALMERS MFG. CO., MILWAUKEE, WISCONSIN. A 1581



4 Infrequently needed speed changes can be had by changing from one size motor sheave to another. Juggling *complete* drives, range is 1:1 to 7:1.



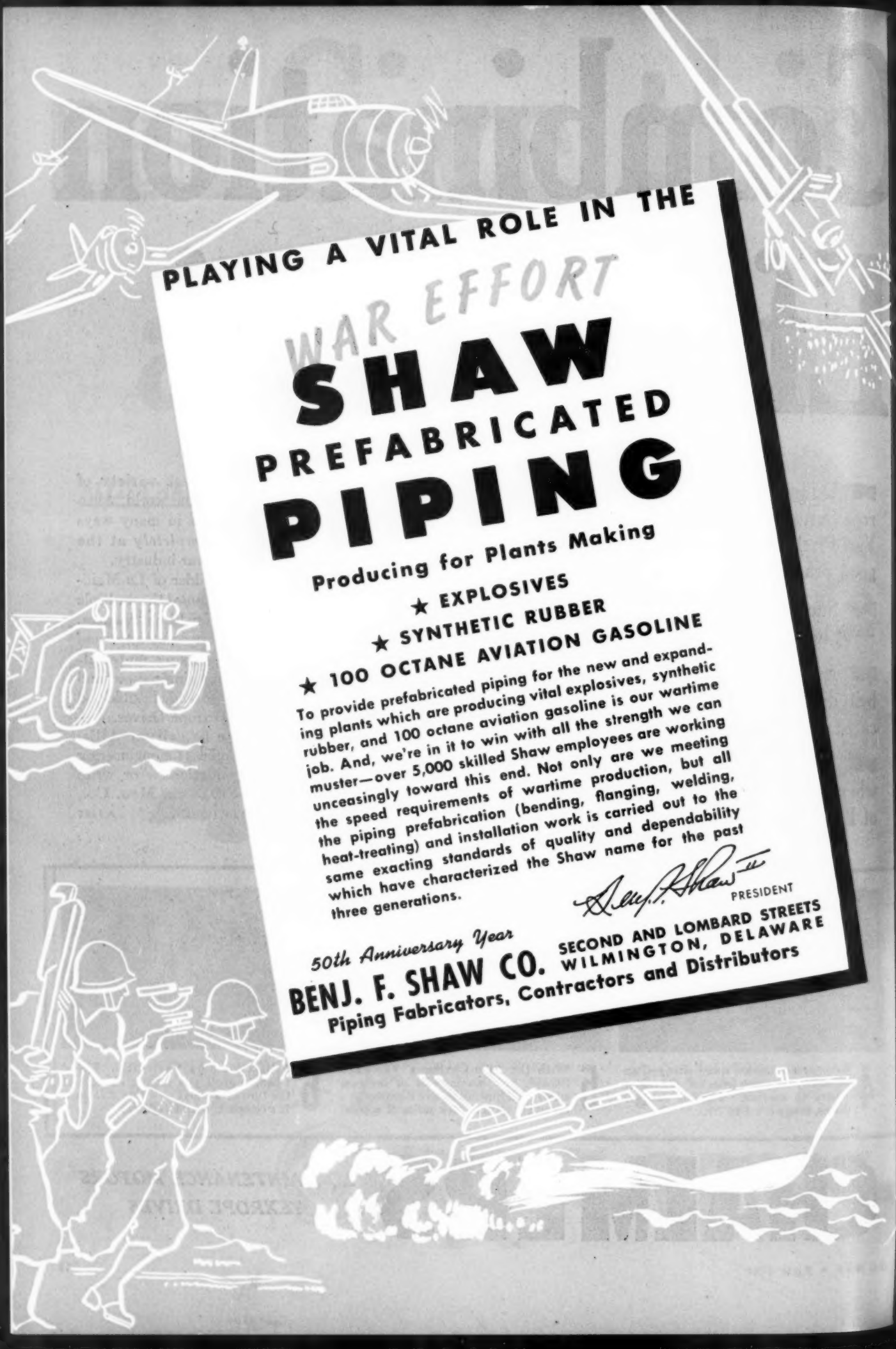
5 With the Allis-Chalmers Vari-Pitch Sheave, you can increase or decrease speed by adjusting sheave diameter . . . obtaining an *unbroken* series of speeds!



6 Allis-Chalmers Vari-Pitch Speed Changer gives you infinite changes at the turn of a wheel — within 3.75 to 1. It's compact, flexible, *efficient!*

ALLIS-CHALMERS

LO-MAINTENANCE MOTORS
TEXROPE DRIVES



PLAYING A VITAL ROLE IN THE

WAR EFFORT

SHAW PREFABRICATED PIPING

Producing for Plants Making

★ EXPLOSIVES

★ SYNTHETIC RUBBER

★ 100 OCTANE AVIATION GASOLINE

To provide prefabricated piping for the new and expanding plants which are producing vital explosives, synthetic rubber, and 100 octane aviation gasoline is our wartime job. And, we're in it to win with all the strength we can muster—over 5,000 skilled Shaw employees are working unceasingly toward this end. Not only are we meeting the speed requirements of wartime production, but all the piping prefabrication (bending, flanging, welding, heat-treating) and installation work is carried out to the same exacting standards of quality and dependability which have characterized the Shaw name for the past three generations.

Benj. F. Shaw III
PRESIDENT

50th Anniversary Year

BENJ. F. SHAW CO. SECOND AND LOMBARD STREETS
WILMINGTON, DELAWARE

Piping Fabricators, Contractors and Distributors

Gathering, editing and distributing INFORMATION for users of alloys

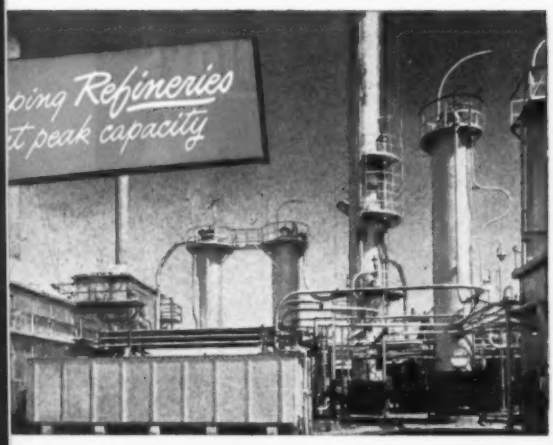
To aid users of Nickel alloys, thirty service centers are maintained in industrial areas. From these strategically located key points, our field representatives are on call to advise American industry about the selection, fabrication and uses of ferrous andnon-ferrousmaterials. Assistance is also given on problems arising from the temporary lack of Nickel.

Through the years, research, field studies and user experience have all contributed to a fund of practical, time-proved information. Many of these data have been compiled in convenient printed form, useful both to experienced men handling new materials or performing unfamiliar operations . . . and to the many new employees.

Now . . . when minutes and materials are so vital . . . make full use of this metal-working experience. Send for a check list of helpful printed pieces on the selection, treatment, fabrication and use of Nickel alloys, or send your specific questions to:

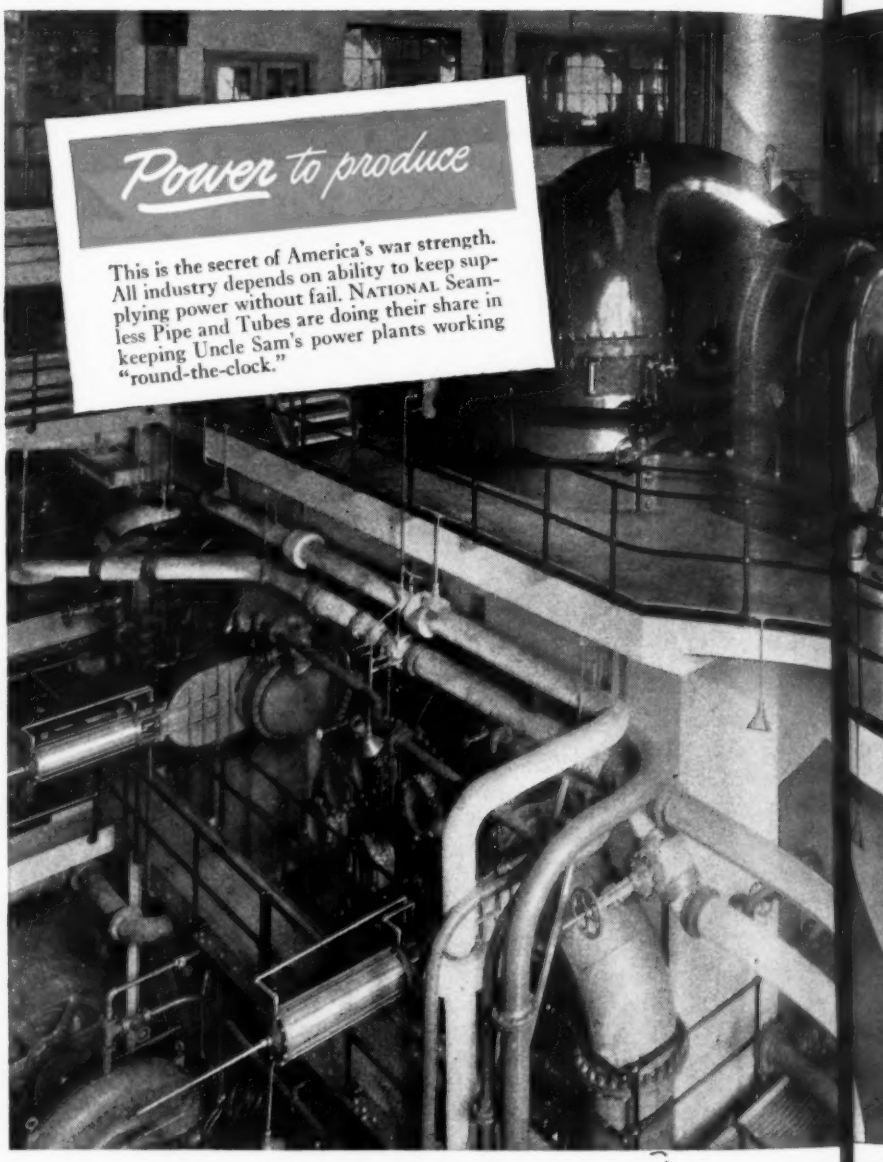
THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

PIPE helps American Industry



That's a job for NATIONAL Seamless Alloy Tubes—they are erving in many of America's leading gasoline refineries and ynthetic rubber processing plants.

They move the heavy stuff on fast schedules. Locomotives ke this "Big Boy" are kept on the job by NATIONAL eamless Boiler Tubes which have shown extremely long fe in service.



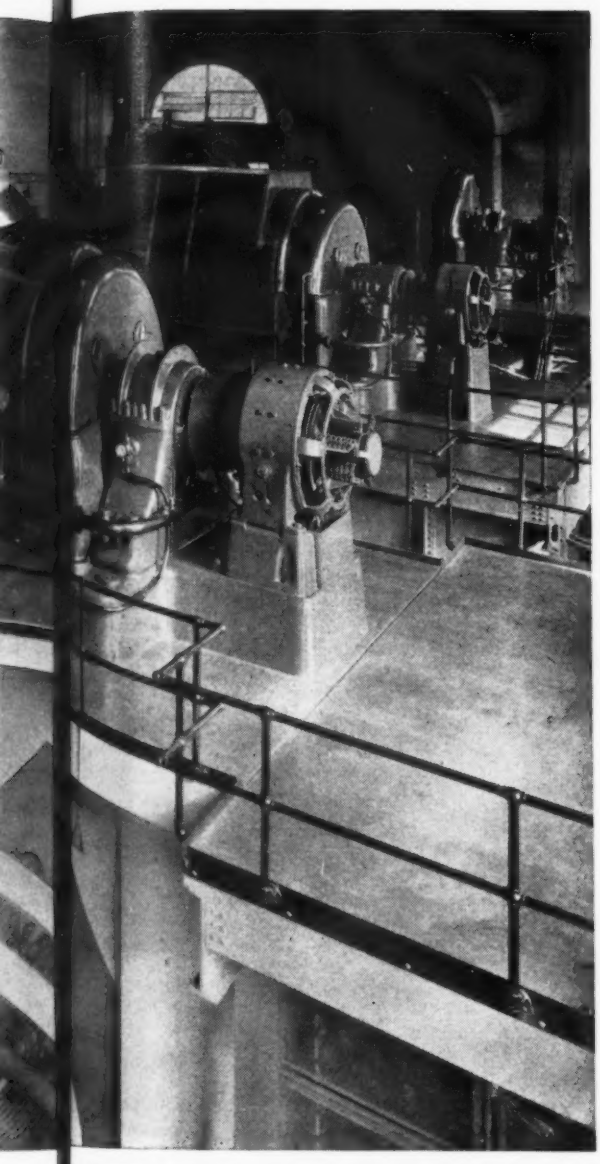
This is the secret of America's war strength. All industry depends on ability to keep supplying power without fail. NATIONAL Seamless Pipe and Tubes are doing their share in keeping Uncle Sam's power plants working "round-the-clock."

Plants of NATIONAL Tube Company have broken records again and again in meeting bigger production schedules for seamless airplane tubing.

Designed to deliver 300,000 barrels of crude a day to the east coast. The first unit from Texas to Illinois has already been completed, using 550 miles of 24-inch NATIONAL Seamless Pipe. Pipe for the second unit is now rolling from our mills.

UNITED

achieve production miracles



IN one short year, America has transformed peace plants to war plants and achieved literally impossible goals of production. The figures were so high that Germany, Italy and Japan scoffed at them as wild dreams. 60,000 planes, 8 million tons of shipping, 45,000 tanks did look like astronomical figures. But at the year's end, most of these goals were well within sight—some even exceeded. This year, at the present rate of production, they will be far surpassed—practically doubled.

Back of these production miracles is a story of men and machines working as they never worked before—a story of equipment pushed to the limit of its capacity with mighty little time out—and, basic to all industry, a story of power generated, controlled, and delivered by *pipe*.

As America's largest producer of seamless pipe and tubing, NATIONAL Tube Company's plants are delivering more tonnage than ever before in history. This is going into the ever-expanding program for more ships, more planes, more tanks, and hundreds of other war uses.

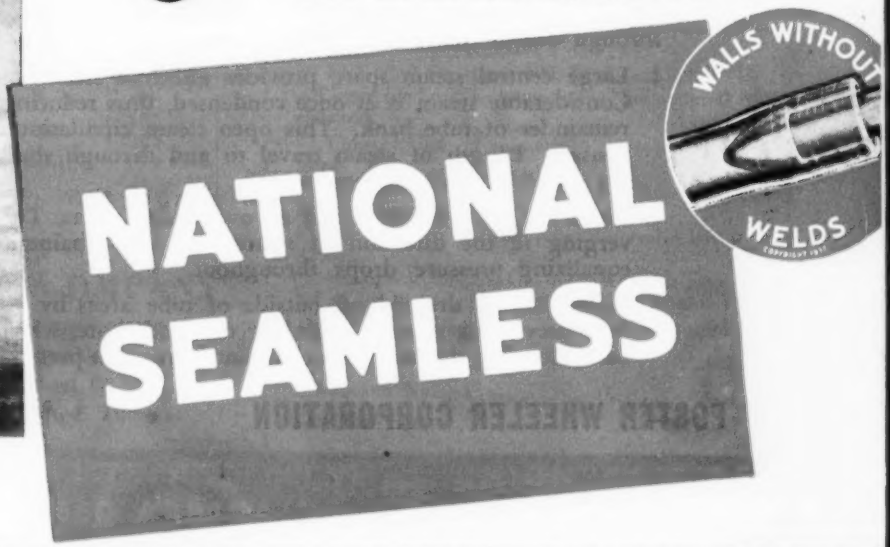
Every day our specialists are helping to work out solutions that keep plants operating longer, that make products lighter and stronger, that save thousands of pounds of steel. If you have a pipe problem in connection with war work, our experience is placed at your disposal without obligation.

NATIONAL TUBE COMPANY

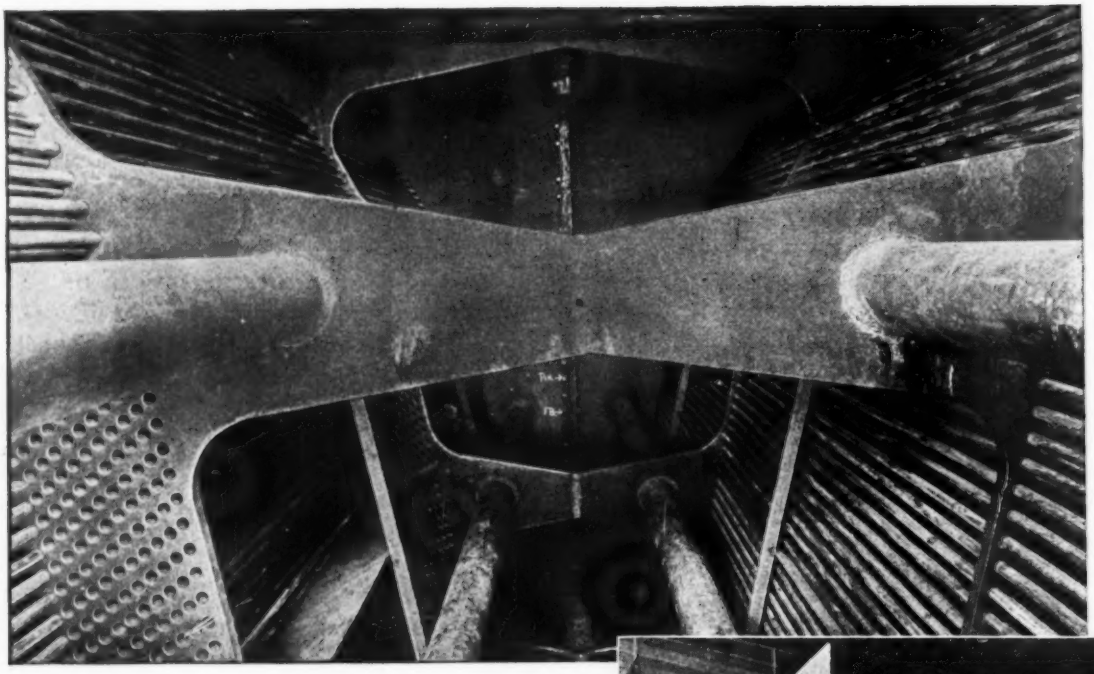
PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

They get their power from boilers—each containing hundreds of seamless steel boiler tubes. NATIONAL plants have kept the supply flowing to meet huge increases in demand.

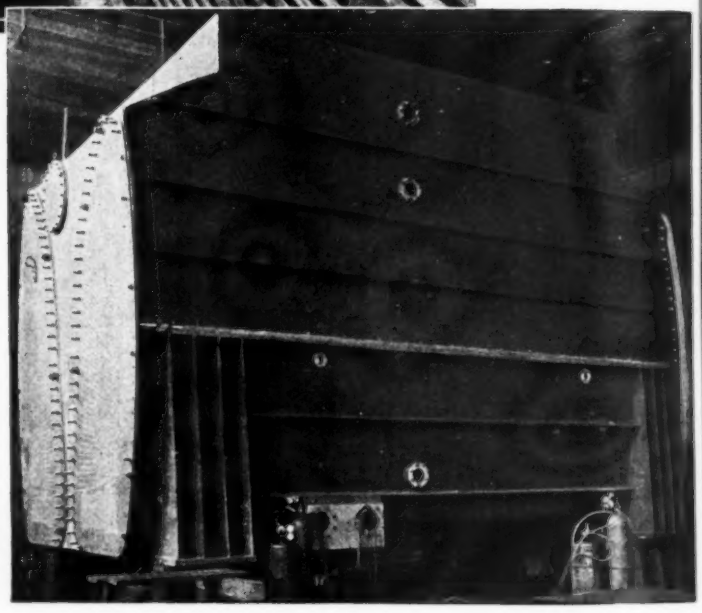


UNITED STATES STEEL



Left — Large central steam space dividing condensing tubes into two shallow banks.

Below—40,000 sq. ft. single pass cross-flow condenser. Row of studs outlines rectangular tube banks.



CROSS FLOW CONDENSER

HIGH-VACUUM —LOW CONDENSATE DEPRESSION

Efficient condenser performance depends primarily on maintenance of high vacuum and low condensate depression. Foster Wheeler cross-flow construction achieves these objectives through design characteristics:

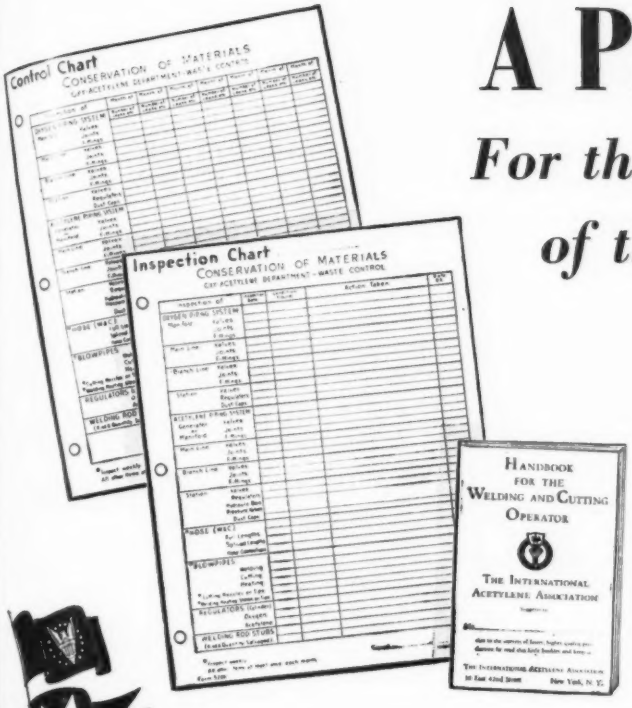
1. Large central steam space provides effective steam distribution over condensing surface. Considerable steam is at once condensed, thus reducing velocity and pressure drop through remainder of tube bank. This open steam circulation also effects positive heating of condensate. Length of steam travel to and through shallow tube banks is shortened affording easier, quicker condensation.
2. There are no dead zones and no overloaded zones. Tubes are spaced on straight lines converging in the direction of steam flow thus maintaining a steadier steam velocity and equalizing pressure drops throughout.
3. Condensate is drained off outside of tube areas by sloping baffles parallel to steam flow, thus preventing excessive cooling of condensate, which otherwise would fall through tube bank clogging the area with resultant increase in pressure drop and decrease in heat transfer.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK, N. Y.

FOSTER WHEELER

A PLANNED PROGRAM

For the Control of Waste in use of the Oxy-Acetylene Process



MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

The greatest over-all losses of oxygen and acetylene come from little things at many points—such as small leaks at fittings, leaky hose, and minor faults of operators, both experienced and new. An effective method for control of such waste must strike at each one of these small points.

Elimination of leaks and wasteful practices requires a planned program, the responsibility for which must be shared equally by management and operators. To help put such a program into effect, the Linde organization suggests the following plan be adopted—modified as needed to fit each shop.

1. **Appoint an inspector** to check regularly the piping system, the hose, and the apparatus while the equipment is in operation. Besides soapy water and a brush to test for leaks, wrenches, and a simple repair kit, he should have some form of INSPECTION CHART such as that shown above and a map of the oxy-acetylene system on which to record tests, repairs, and other pertinent information. *Sample copies of this chart (Form 5206), and of a map (Form 5207), will be sent by Linde without charge.*

2. **Summarize the inspection data** on a master CONTROL CHART such as that shown above. This will give plant executives an over-all picture of the waste control program. *Copies of this chart (Form 5205) are available from Linde.*

3. **Co-operation of every operator** should be solicited for the success of this waste control program. To remind operators of the many little ways in which waste can be avoided, Linde will send as many copies as you need of a vest-pocket-sized booklet, published by the International Acetylene Association, that presents the conservation story in a series of illustrated "do's" and "don't's." *Every operator should have a copy of this little handbook.*

The program outlined above will not only help to assure continued adequate supplies of oxygen and acetylene, but should also more than pay for itself in lowered costs and increased efficiency. For samples of the charts described above, and for handbooks for your operators, send the coupon, or ask any Linde office.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street, New York, N. Y. — UCC — Offices in Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

THE LINDE AIR PRODUCTS COMPANY
30 East 42nd St., Room 308, New York, N. Y.

Please send me, without charge, the material I have checked.

☐ Conservation of Materials—Inspection Chart—Form 5206.

☐ Specimen Inspectors' Map of Oxy-Acetylene Piping System—Form 5207.

☐ Conservation of Materials—Control Chart—Form 5205.

☐ Handbook for the Oxy-Acetylene Operator—published by the International Acetylene Association.

(Specify the quantity of Handbooks required) .....

Name .....

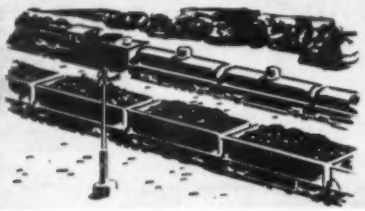
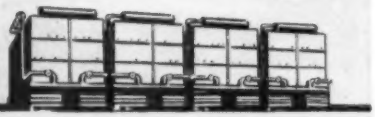
Street and No. .....

City and State .....

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," and "Prest-O-Weld" are trade-marks.

First Aid Chart

	WAR CONDITIONS	POWER PROBLEMS
Manpower	Skilled operators being called for military service. Fewer experienced operators available for replacement. Inexperienced men to be trained.	Power plants must be operated at maximum capacity and efficiency with fewer skilled operators who, at the same time, must aid in the training of new and inexperienced men.
Fuel 	Transportation difficulties threaten curtailment of fuel shipments causing temporary fuel shortages.	Emergency fuel must be obtained and stored. Available fuel must be burned at maximum efficiency to stretch present supply and to minimize haulage. Must be prepared to burn a substitute fuel if necessary.
Steam 	Big increase in steam demand. Lack of generating capacity. New steam generating equipment hard to get even with good priorities.	Every possible pound of steam must be squeezed from present generating units to meet new load demand. Process steam waste must be checked and held to a minimum.
Maintenance	All equipment operating at overload. No stand-by equipment. Replacement parts difficult to obtain. Inexperienced operators.	Maintenance and repairs must be taken care of promptly, in spite of a shortage of experienced maintenance men or difficulties in getting materials, in order to avoid major shut-downs.

REPUBLIC
INSTRUMENTS
AND CONTROLS

FOR SOLVING WARTIME POWER PLANT PROBLEMS

THROUGH the use of instruments and controls you may be able to increase your steam supply just enough to get it over the peak. Republic engineers will be glad to consult with you. Write to us today.

INSTRUMENTS	BOILER CONTROLS	PROCESS CONTROLS
IMPROVE SUPERVISION Instruments provide operators with continuous indications of operating conditions. Permit centralized supervision of all operating factors. Provide continuous record of performance.	**CONSERVE MANPOWER** Automatic boiler controls, by performing the routine repetitive adjustments, free the operators for more important supervisory duties.	**STRETCH SKILL** Automatically perform routine repetitive adjustments to maintain desired conditions thereby enabling the operator to surpervise the operation of a larger number of units.
CHECK LOSSES CO_2 meters, draft gages and flue gas temperature recorders provide a continuous check on combustion efficiency and preventable heat losses. Steam meters serve as a guide for the proper load distribution among boilers.	**SAVE FUEL** Automatically maintain highest combustion efficiency by controlling fuel and air input, in a fixed predetermined ratio, over the normal load range. Provide for changes in fuel characteristics and other operating factors.	**REDUCE WASTE** For every pound of steam wasted and for each extra gallon of watar pumped, etc., a corresponding amount of fuel had to be consumed in the boiler room. Automatic controls reduce power waste and thereby save fuel.
CHECK STEAM WASTE Meters installed on main distribution lines will immediately center attention on the department or unit using excessive amounts of steam. They provide the information needed to coordinate steam consumption with steam production.	**TEST EFFICIENCY** Produce maximum steam output at test efficiency by maintaining constant steam pressure, maximum combustion efficiency, constant and correct furnace draft and desired load division among boilers.	**MORE STEAM** By reducing the power consumption of pumps, compressors, dryers or other steam consuming units, through the use of automatic controls, you increase the effective capacity of your power plant.
LOCATE TROUBLE SPOTS Instruments, by providing a check on the performance of various units, are invaluable in spotting potential trouble spots before they develop to a point where they require extensive repairs and interfere with production.	**REDUCE OUTAGES** Correct boiler operation reduces outages. Boiler controls, by coordinating all operating factors, prevent the chain-of-events type of trouble that may lead to serious shut-downs.	**UNIFORM PERFORMANCE** Maintain correct process conditions under continuous operation at peak capacity. When both operators and equipment are working at capacity close control is vital to prevent serious maintenance outages.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago, Illinois

C-E STEAM GENERATING U

MEET THE DIVERSIFIED STEAM N

OF SYNTHETIC RUBBER PLANTS

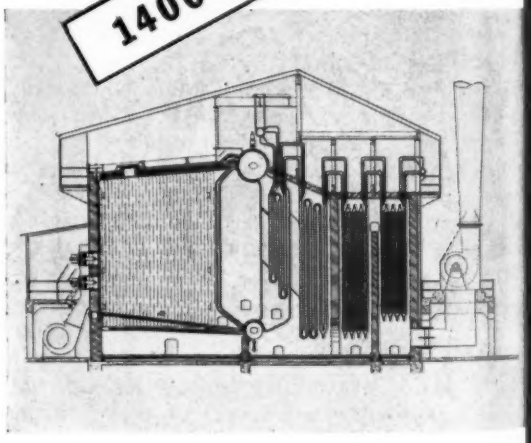
How the diversity of C-E steam generating equipment is meeting the needs of the new synthetic rubber plants is illustrated in part by these three different types of units which are among those now under construction.

One is the new forced-circulation design recently introduced by C-E. One is natural circulation, employing the standardized VU Unit which has its own special advantages. One is a separately-fired superheater especially designed to produce steam at 1400 F. Taken collectively they represent three types of firing—pulverized coal, gas and oil.

It is natural for the synthetic rubber plants with their new and peculiar problems to turn to C-E where they find the most complete line of boilers available anywhere; the specialized knowledge required to design superheaters to produce steam at 1400 F; every size and type of fuel-burning equipment; and the engineering skill which has been responsible for many of the leading achievements in the field of steam generation.

A-688-A

1400 F STEAM TEMP.



Specially designed unit to produce steam at 1400 F. A water-cooled furnace precedes the four bank superheater.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HE

COMBUSTION

...IGUNITS

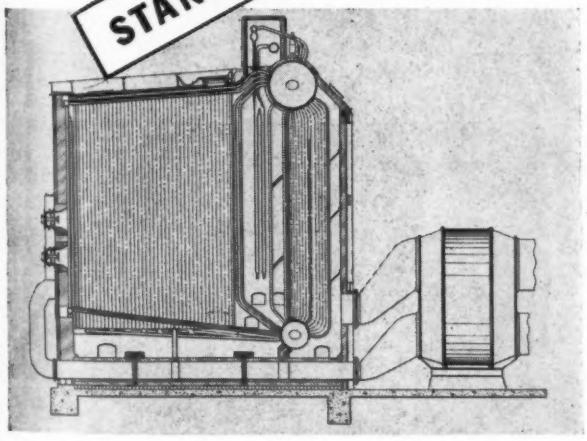
...AMNEEDS

...TS

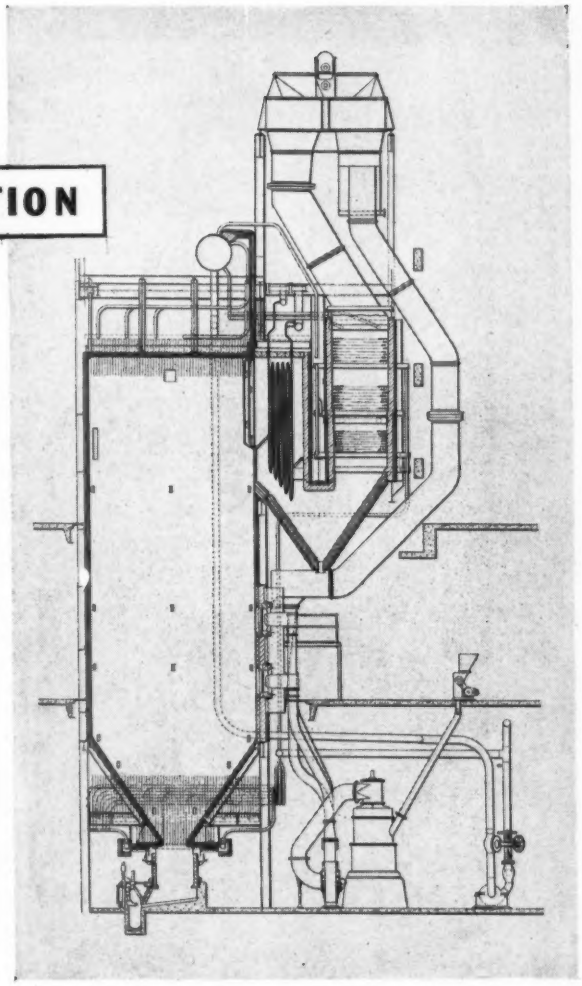
...P.

FORCED CIRCULATION

STANDARD VU DESIGN



C-E Steam Generator, Type VU. Capacity—300,000 lb steam per hr. Design Pressure—800 psi. Total Steam Temperature—750 F.

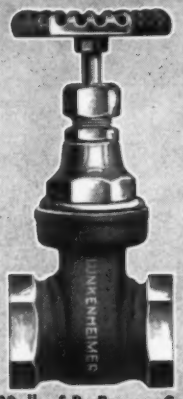


C-E Controlled, Forced-circulation Boiler. Capacity—350,000 lb of steam per hr. Design Pressure—800 psi. Total Steam Temperature—750 F.

...AIR HE... ...USTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • CANADA: COMBUSTION ENGINEERING CORPORATION LTD., MONTREAL

...NGINEERING

150 lb. S.P. Bronze Gate
Double Wedge Disc
Rising Stem



200 lb. S.P. Bronze Gate
Single Wedge Disc
Non-Rising Stem

125 lb. S.P. Bronze Gate
Double Wedge Disc
Rising Stem

125 lb. S.P. Bronze Gate
Single Wedge Disc
Non-Rising Stem

300 lb. S.P. Bronze Gate
Single Wedge Disc
Non-Rising Stem

1000 lb. W.O.G. Bronze Gate
Single Wedge Disc
Non-Rising Stem

QUALITY COUNTS Now More Than Ever

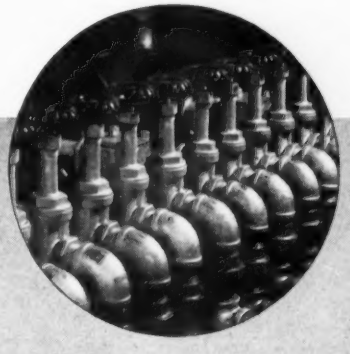
Quality in valves has always been synonymous with the name "Lunkenheimer" and through the years Lunkenheimer Quality has been the standard by which good valves are judged. Constant improvement and refinement have kept Lunkenheimer abreast of ever-changing conditions and requirements.

When unprecedented demands arose to produce essential war equipment for the Army, Navy, Maritime Commission and Air Force, Lunkenheimer facilities naturally were called upon to provide necessary valves, boiler mountings, lubricating devices and aircraft fittings. And now, with the entire productive capacity devoted to war work, less important requirements must be deferred.

However, when post-war conditions come, Lunkenheimer will be ready to meet the demands of constantly changing processes for advanced designs of improved quality for every industrial application.

The complete facilities of Lunkenheimer distributors are at your serice. They'll go all out to help you get the things you need.

Ask for Lunkenheimer Catalog 78 and the Guide for selecting Valves, Boiler Mountings and Lubricating Devices.



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THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI, OHIO, U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

No. 28-107-42

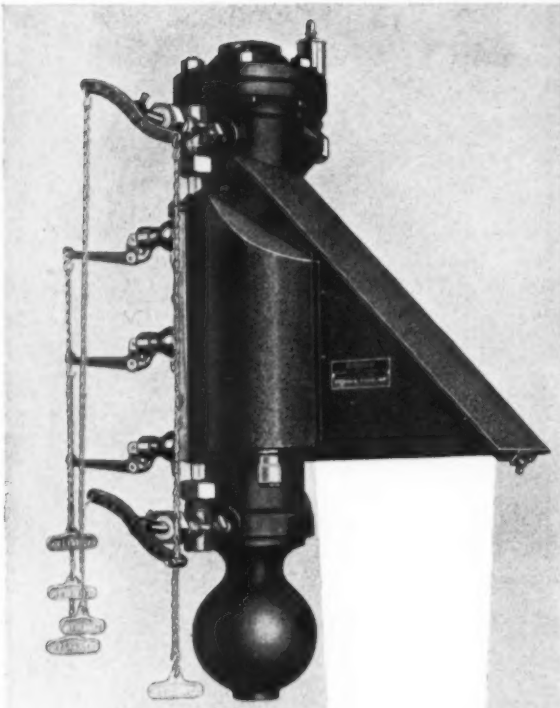


Figure 1
Reliance *TILTVIEW* Tubular Water Gage.

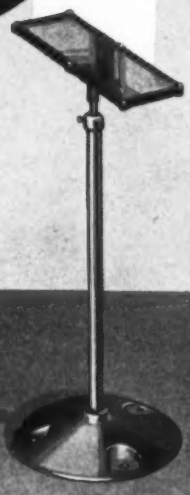


Figure 2
Periscope illuminator and mirror stand for use with Prismatic Gage Insert.

You can prevent "Boiler

Power stoppage that brings war wheels to a standstill is something every power plant operator sincerely wants to avoid... Don't let faulty vision of a water gage spoil your record...

WHAT GOOD is a gage that's only partially visible? It will pay to check yours—to insist upon improved visibility if there's any question about getting a quick, accurate reading, even for eyes that aren't sharp enough for military needs. For this traditional guardian has saved many a boiler outage. Now, of all times, every check, every control should serve efficiently, keeping full power available for production demands. . . . Is there something you can do to guarantee safe, positive water level gage visibility? Here are a few suggestions:

THE RELIANCE GAUGE COLUMN CO.

Since 1884

Reliance

"Absenteeism" . . . too often caused by Faulty Water Level Indication

Suggestion 1. If your working pressure is moderate and tubular glasses are used, keep them clean and well lighted. But if mounted vertically and well above the operating floor, the Reliance Tiltview Water Gage improves visibility with its glass inclined at 30° (See Figure 1).

Suggestion 2. Where your water column is very high or partially hidden by catwalks or structural work, visibility usually can be improved by Periscope Illumination. This is available with Prismatic Water Gage Inserts —usable up through the medium pressures (see Figure 2) or for Mica-protected Flat Glass Inserts on higher pressures. The water level image is projected from Periscope down to Mirror Stand with mistake-proof clarity.

Suggestion 3. If your high pressure water columns are mounted in full view of the floor but at considerable height, we suggest "direct vision illumination" of specialized design (see Figure 3). In Mica-protected Flat Glass Inserts or Micasights the water level meniscus is lighted to glow like a prominent star (see Figure 4) — its brilliancy enhanced by the darkness in the front hood well.

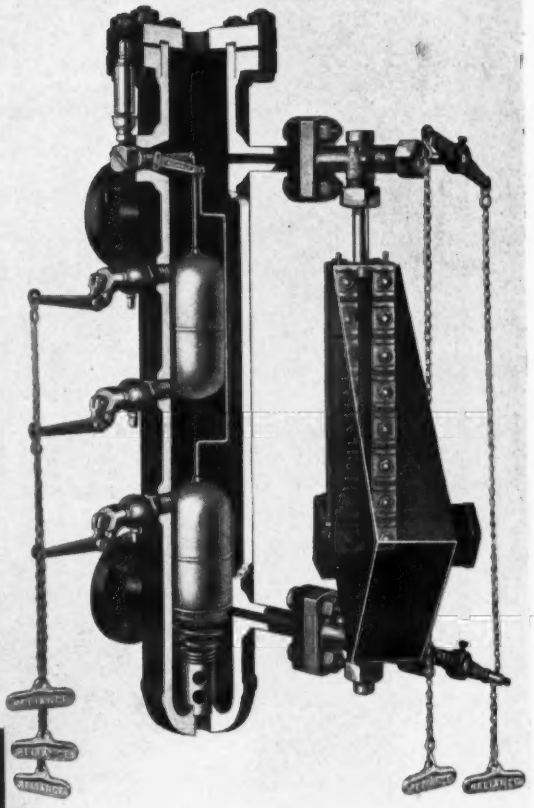


Figure 3—Direct Vision Illuminator for Mica-protected Flat Glass Inserts mounted on Reliance High and Low Alarm Water Column. . . . . .

The application of these suggestions to your gage visibility problems is a responsibility Reliance gladly assumes, at your invitation. Over half a century of experience in Boiler Safety Devices is at your disposal to help prevent boiler outage with adequate water level supervision. Representatives in all principal cities are ready to serve you.

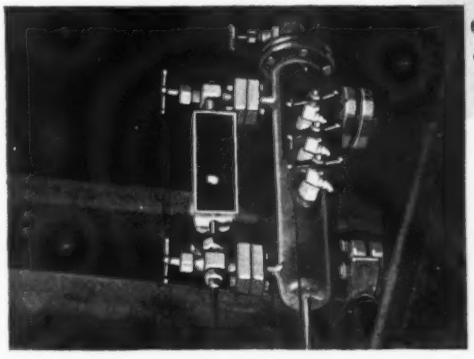
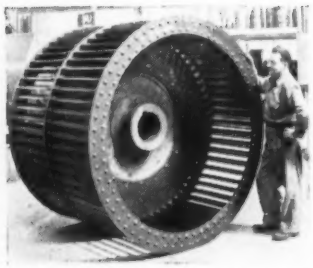


Figure 4—Typical installation view showing clarity of the water level image. . . .

5902 CARNEGIE AVENUE · CLEVELAND, OHIO

BOILER SAFETY DEVICES

Progress and Power in the



Wheel of the Sirocco Fan extensively used in the plants of America's vital steel industry.

The prophecy, "Liberty for the World," is being written in steel made in America!

With shattering eloquence, steel is squelching the boasts of the tyrants. More than ever before in the history of America, the future of America and the future of the world depend upon the ability of this nation's steel producers to supply the enormous quantities needed.

America's electric power producers know the importance of steel. And the steel producers are equally aware of the vital need for electric power.

American Blower has had the privilege of supplying Air Handling Equipment of many types, as well as Fluid Drives, for both the Utilities and the Steel Plants.

We feel that the dependable, uninterrupted operation of these American Blower products, in war as in peace, is evidence of the sincerity of our efforts to build only the best equipment of its kind.

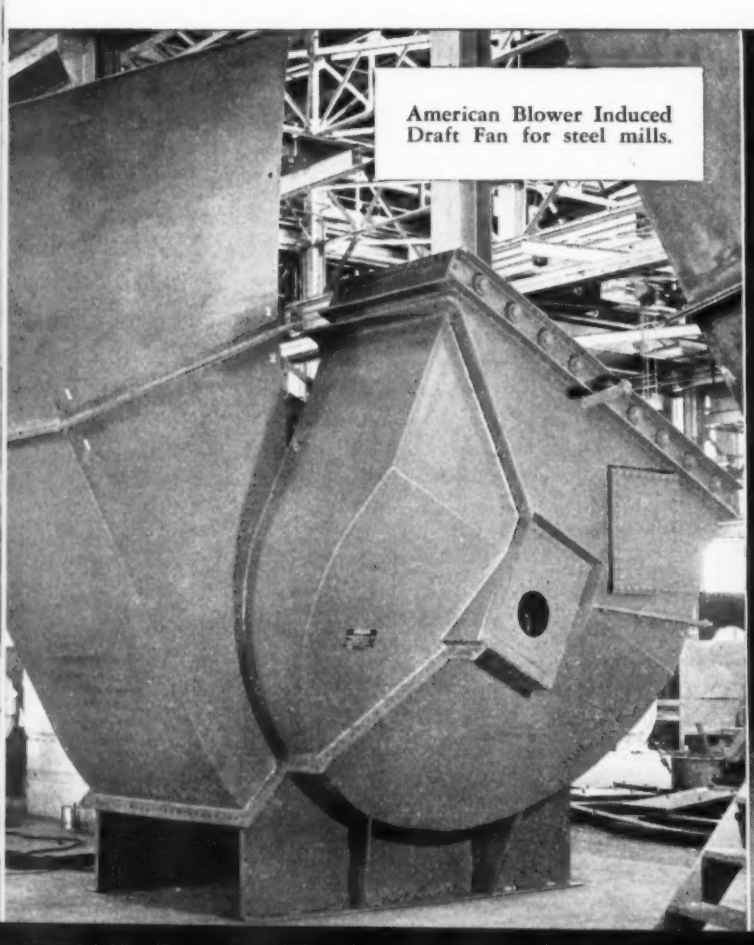
American Blower plants fly the Army-Navy "E."

AMERICAN BLOWER

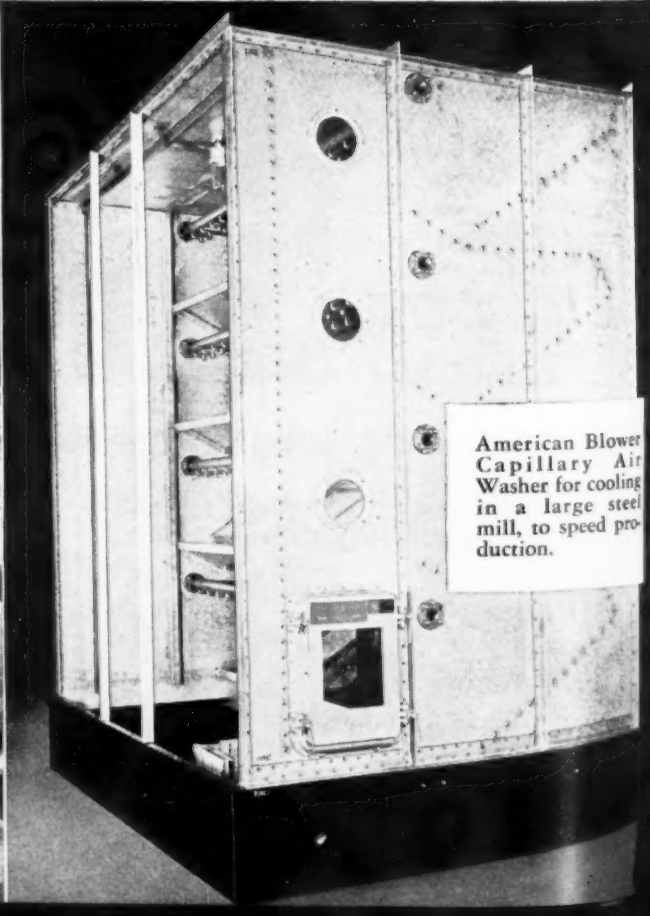
AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN

In Canada: CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO

Division of AMERICAN Radiator and Standard Sanitary Corporation

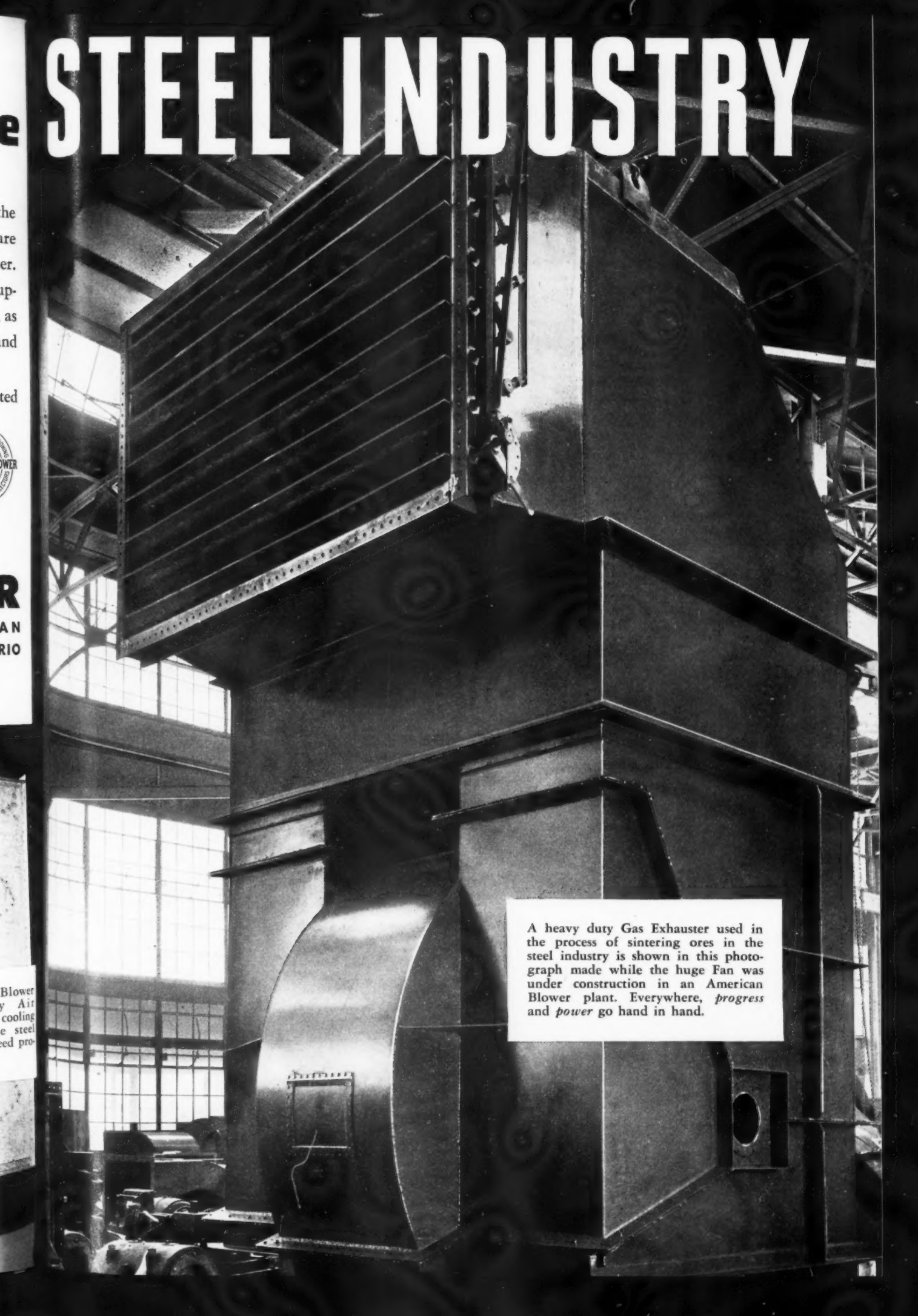


American Blower Induced Draft Fan for steel mills.



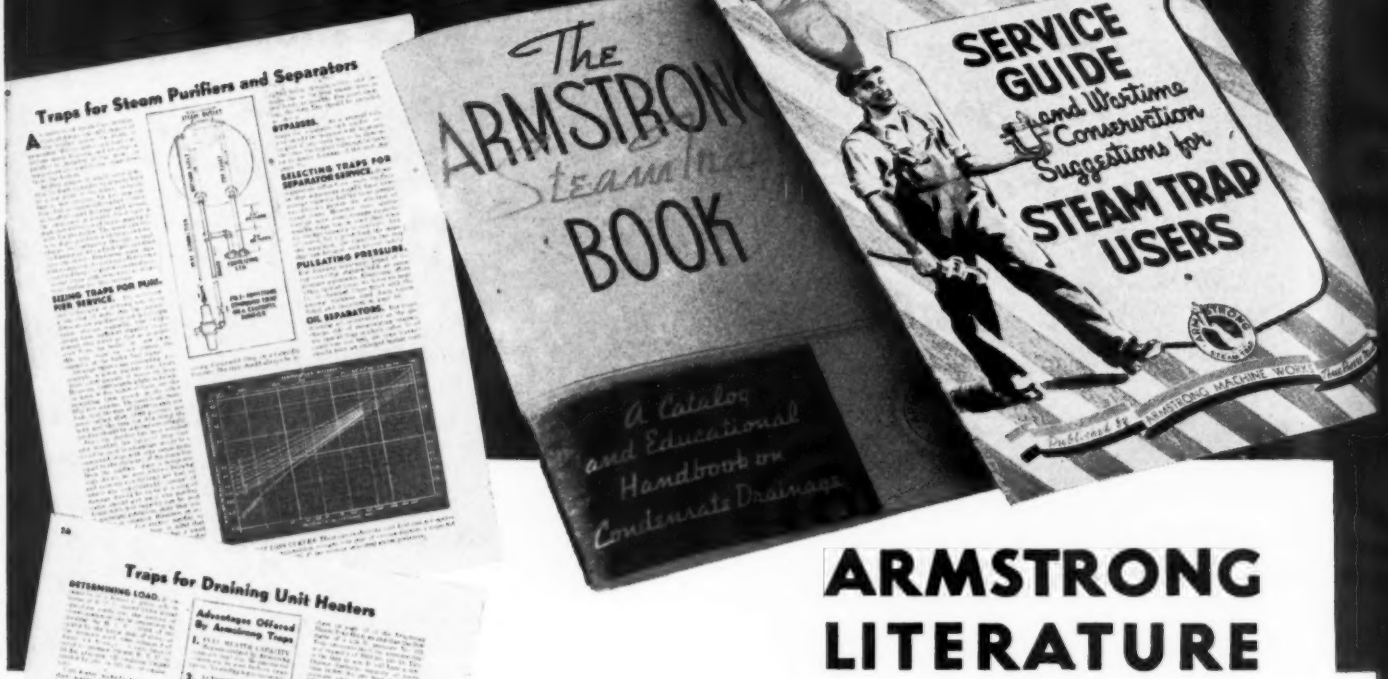
American Blower Capillary Air Washer for cooling in a large steel mill, to speed production.

STEEL INDUSTRY



A heavy duty Gas Exhauster used in the process of sintering ores in the steel industry is shown in this photograph made while the huge Fan was under construction in an American Blower plant. Everywhere, *progress* and *power* go hand in hand.

Here's HELP


Traps for Steam Purifiers and Separators
The ARMSTRONG Steam Trap BOOK
A Catalog and Educational Handbook on Condensate Drainage
SERVICE GUIDE
and Wartime Conservation Suggestions for
STEAM TRAP USERS
ARMSTRONG MACHINE WORKS

ARMSTRONG LITERATURE

Proper trap selection is a quick, easy process when you have the Armstrong Steam Trap Book. The capacity chart shows actual hot condensate capacity of each size trap over its entire pressure range. Tables and charts include warming up loads, radiation loads, safety factors and other data to make it possible to select the right trap for the job. Information on good drainage practice, proper trap installation and do's and dont's assure you of maximum effectiveness from your trapping.

For trouble shooting, maintenance and repairs, the Armstrong Service Guide is a real help in wartime when time, labor and material are scarce.

Send for a copy of either or both of these booklets today. No obligation.

ARMSTRONG · INVERTED BUCKET · STEAM TRAP

Armstrong

for Busy Engineers

ARMSTRONG TRAPS

Armstrong Steam Traps are noted steam savers. They'll help you get more capacity out of overloaded boilers, give you faster heating and higher production and save fuel. There's a size and type for pressures from a fraction of a pound up to 2400 lbs.; for capacities up to 300,000 lbs. per hour. They are easy to install with a minimum of labor and fittings. Diagrams at the right show installation flexibility.

Armstrong Traps seldom need attention, but when they do, inspection is a matter of seconds and repairs are simple and quickly made.

The right traps — traps that are sturdy, rugged and dependable — can play an important role in keeping your plant rolling under forced draft.

Call your local Armstrong representative or write direct today.

ARMSTRONG MACHINE WORKS
812 MAPLE STREET • THREE RIVERS, MICHIGAN

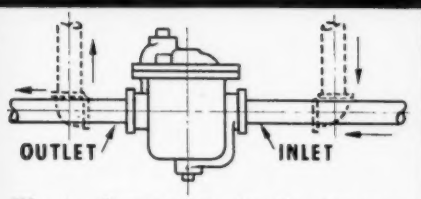


Fig. 1. Connections for No. 200 trap.

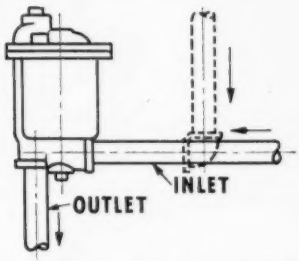


Fig. 2 Connections for No. 201 trap.

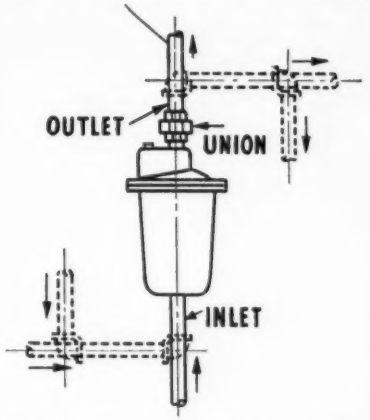


Fig. 3. Connections for No. 211-216 traps

Easy to Install

Three combinations of inlet and outlet connections make possible the best possible hookup for any job.

Easy to Inspect

The cap carries the whole works. No need to disconnect the trap from the line.

STEAM TRAPS

FOR many years "Old Faithful" has been a byword for dependable performance. Once every hour, day in and day out, as far back as man can remember, this famous geyser in Yellowstone Park has spouted for four minutes. In this brief time ten to twelve thousand gallons of water rush forth, the column rising to an average height of 140 feet. Then the flow ceases abruptly, to reoccur an hour later.

Powell Valves, too, are famous for dependability in flow control. Through nearly a century, under ever-increasing pressures and temperatures, Powell Valves have been a byword for dependable performance in the power lines of industrial America.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati, Ohio

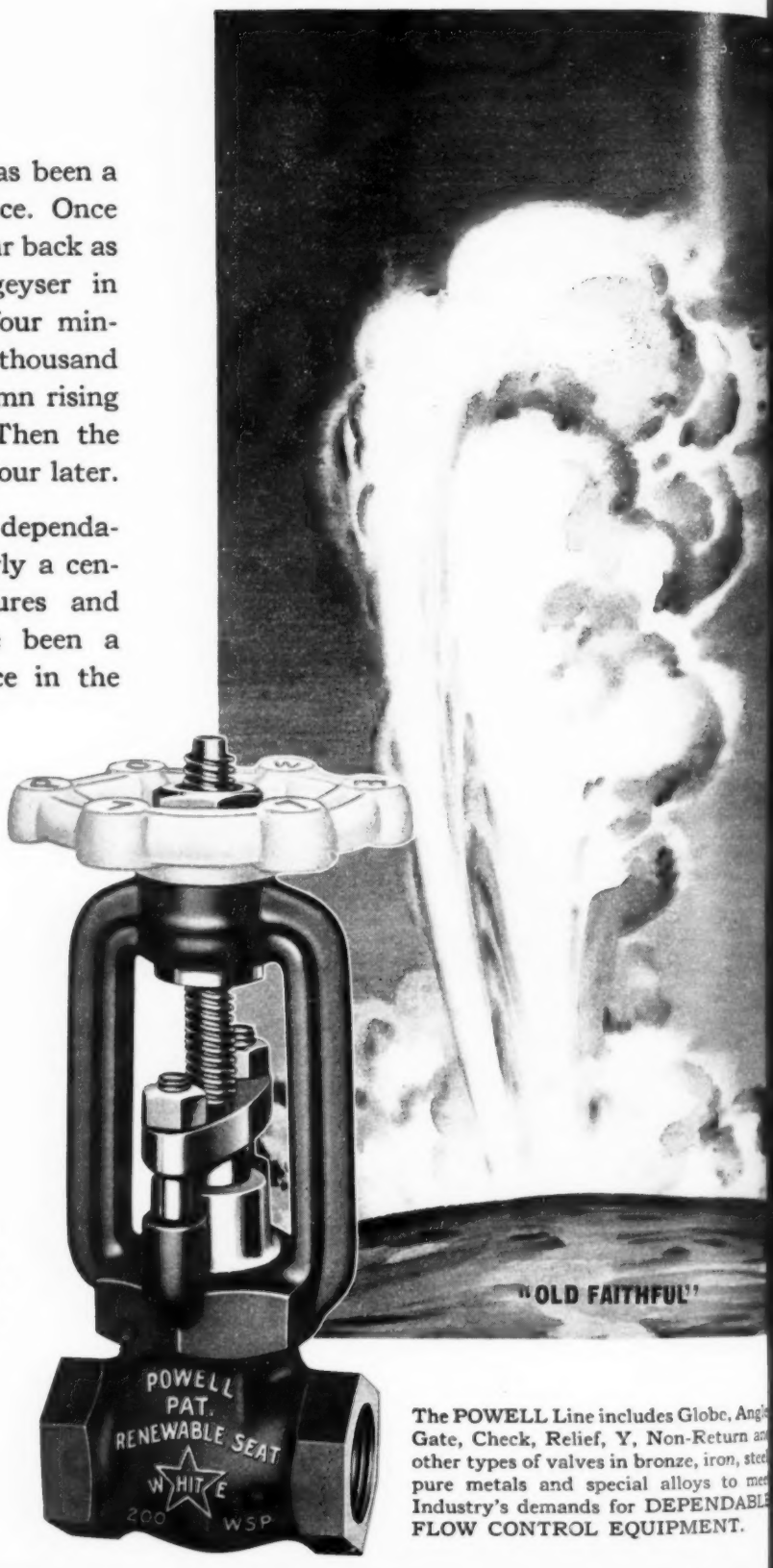


Fig. 386
200-pound Bronze Gate Valve with screwed ends, outside screw rising stem, screwed in yoke bonnet, bolted flanged packing gland, and renewable hard bronze seat rings and taper wedge solid disc. Sizes ½" to 3", inclusive.

The POWELL Line includes Globe, Angle, Gate, Check, Relief, Y, Non-Return and other types of valves in bronze, iron, steel, pure metals and special alloys to meet Industry's demands for DEPENDABLE FLOW CONTROL EQUIPMENT.

POWELL

Fig. 1186
125-pound Bronze Gate Valve with screwed ends, outside screw rising stem, screwed in yoke bonnet bolted flanged packing gland and renewable taper wedge solid disc. Sizes ¾" to 3", inclusive.

Fig. 375
200-pound Bronze Gate Valve with screwed ends, union bonnet, inside screw rising stem and special hard bronze disc. Sizes ¼" to 3", inclusive.

Fig. 500
125-pound Bronze Gate Valve with screwed ends and screwed-in bonnet. Sizes ¼" to ¾" equipped with taper wedge solid disc; sizes 1" to 3" with taper wedge double disc.

VALVES

TERROR FROM THE SKIES

On many fronts our air-borne invaders are striking terror in the hearts of our enemies. For war today is three-dimensional, and mountains, deserts, seas and fortifications offer no obstacles to U. S. Paratroops.

Transporting armies through the air is a big job—a job that calls for big planes and big engines. Today, engines of 2,000 horsepower are commonplace. Already on testing blocks, in manufacturing departments and on drawing boards, in engine plants throughout the country, is the promise of engines that will dwarf even these giants.

And transmitting the power from these engines are gears of such light weight—of such extreme precision, metallurgically and dimensionally, that engineers marvel that they could be produced by mass production methods.

How the problems that were presented in their design and manufacture were overcome is a military secret. But the mounting figures of our aircraft production is proof that here at Foote Bros. these precision gears are rolling off production lines in an amazing volume.

When the war is won, these same gears give promise of revolutionary advantages in the design of machinery—advantages that will mean "better power transmission through better gears."

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 South Western Boulevard
CHICAGO

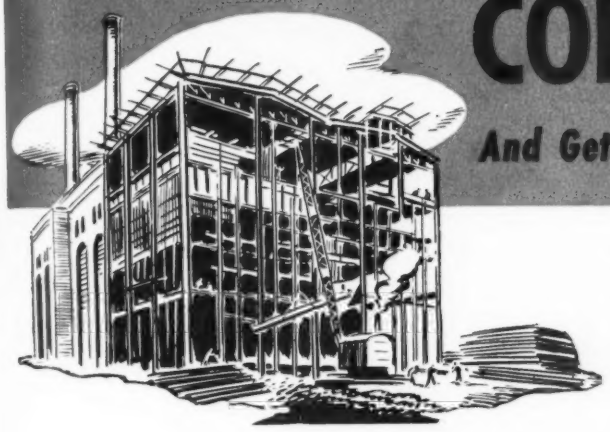
To assist Paratroops in recognizing arms, ammunition and supplies instantly, colored parachutes are used. Pictured here are men and equipment descending upon a foreign airfield.

FOOTE BROS.

Better Power Transmission Through Better Gears

HOW WAR PLANTS ARE SAVING COPPER AND TIME

And Getting BETTER Electric Power Systems



EXPANDING war plants today must get power systems quickly—and yet *save* copper and other materials. Application of the methods outlined here will accomplish both these results—and *also* provide a better-than-ever system. Here's how it is done—

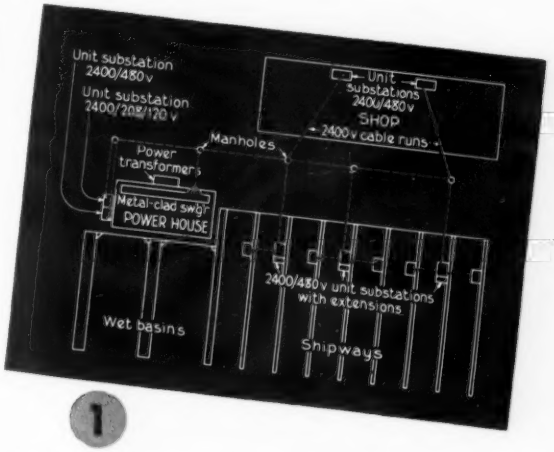
By Using Load-center Distribution

You can avoid long runs of heavy-copper secondaries by running the highest practical voltage direct to relatively small-size unit substations at the *centers* of the load areas, and save tons of cable copper.

Installing substations at the *centers* rather than at the sides of square load areas requires 30 to 40 per cent less copper.

By using four small substations rather than one large substation to serve a square load area, you need only half as much cable copper.

This is both practical and economical with modern safety-enclosed load-center units. These units, consisting of *Pyranol* transformers and *metal-enclosed* switchgear, can be safely installed right in working areas. Bulky, expensive vaults are unnecessary.

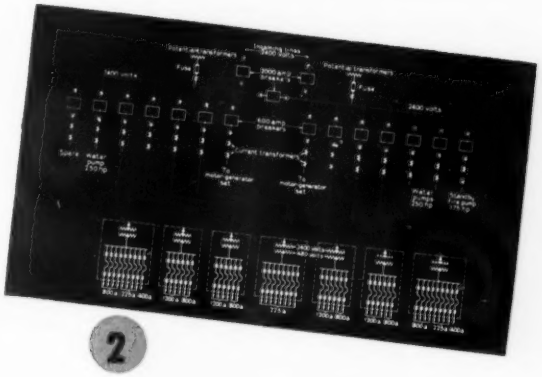


1

High-voltage is run directly to unit substations at *load centers*.

. . . And by Ordering STANDARD SAFETY-ENCLOSED Equipment EARLY

Standard means quick, easy selection and ordering. Safety-enclosed means an exceedingly high degree of flexibility as to location. Together, these advantages enable engineers to provide power in time to meet today's stepped-up schedules.



2

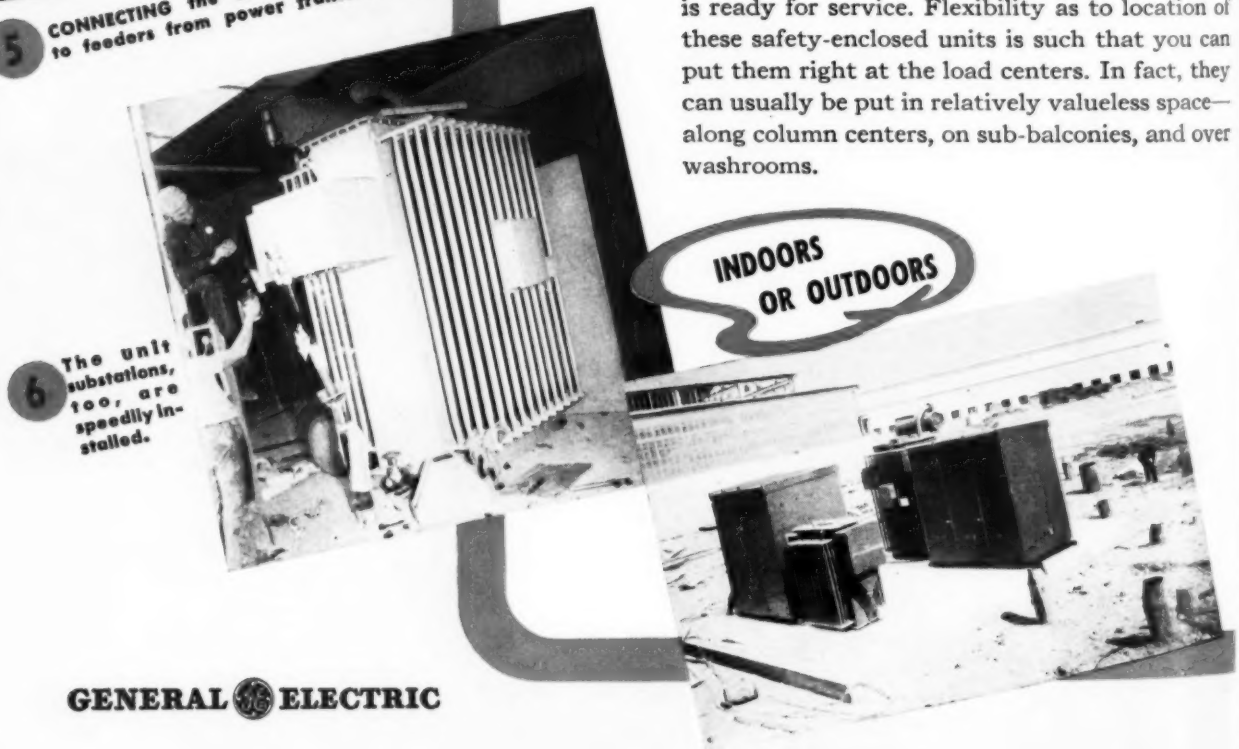
A simple one-line diagram is all that is needed for selection and ordering *standard* load-center unit substations and switchgear. This can be done when the plant or extension is in the first stage of construction.

Do This And . . .

GENERAL ELECTRIC

. . . THEN YOU CAN INSTALL YOUR POWER SYSTEM *Early and Easily*

On arrival, the safety-enclosed switchgear equipments are quickly installed by - -
3 SLIDING the units into their final position.
4 JACKING them down onto their sills, using a jack at each corner.



Safety-enclosed switchgear and load-center unit substations are completely factory-assembled, and are shipped in compact, easy-to-handle units that arrive all ready to be set in place and connected.

THE SAFETY-ENCLOSED SWITCHGEAR CAN BE QUICKLY INSTALLED simply by a "slide, jack, and connect" operation, as shown at the left. Each equipment is a safe, co-ordinated, unit assembly including circuit breakers, buses, and all associated equipment.

Because these compact units dependably perform any desired combination of functions, they save you the extra time and materials needed to select and install open-type exposed switchgear which necessitates long, wasteful copper interconnections.

YOU CAN PUT IN THE UNIT SUBS JUST AS QUICKLY—INDOORS OR OUT. On arrival, the transformer and switchgear sections of the unit substation are moved into position and bolted together. Connections are made to the incoming and outgoing circuits, and the unit substation is ready for service. Flexibility as to location of these safety-enclosed units is such that you can put them right at the load centers. In fact, they can usually be put in relatively valueless space—along column centers, on sub-balconies, and over washrooms.

GENERAL ELECTRIC

EARLY INSTALLATION SPEEDS THE REMAINING CONSTRUCTION WORK——

Compact, standard unit substations —ordered early and installed the flexible, load-center way—have gone into service in scores of new or enlarged war plants weeks before construction was completed. In this way a ready, dependable supply of power is made available for all the power-driven tools and equipment needed to complete the construction. This eliminates the job of improvising a "temporary" power system that often presents a hazard to workers and is subject to power interruptions. It also eliminates a later change-over to the permanent system.

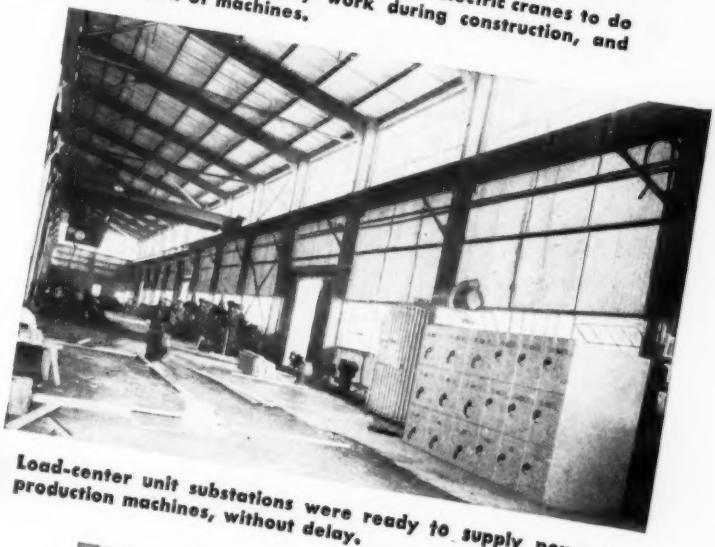
——AND GETS PRODUCTION MACHINES ROLLING AS SOON AS POSSIBLE

Production machines need not stand idle waiting for an electric power system that couldn't be ordered until the building and the exact load locations "took shape." The flexible load-center system easily follows last-minute rearrangement of the machines, and can safely be ordered in time to arrive when needed.

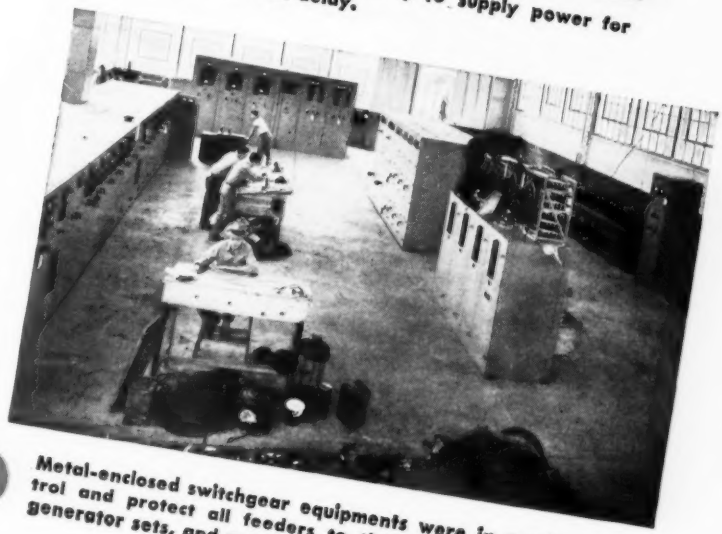
From the very start, you get full protection for both production and personnel. The primary feeders are controlled and protected by metal-clad switchgear equipments so safe that workers can be located near them. Low-voltage feeders from the load-center unit substations are likewise protected by metal-enclosed drawout-breaker equipments that form an integral part of the unit substation.

In this new war plant—

7 The power system was installed in time for electric cranes to do much of the remaining heavy work during construction, and during installation of machines.



8 Load-center unit substations were ready to supply power for production machines, without delay.

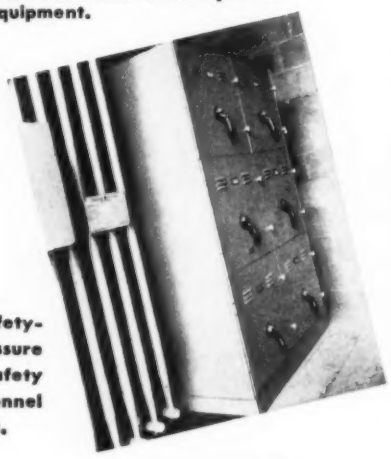


9 Metal-enclosed switchgear equipments were in service to control and protect all feeders to the unit substations, motor-generator sets, and pumps.

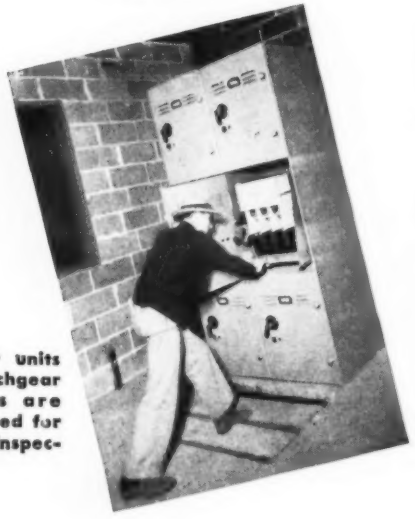
Now—ADD UP THE ADVANTAGES

Packaged load-center unit substations GIVE YOU THESE ALL-IMPORTANT SAVINGS

10 Many tons of copper are saved by distributing power at primary voltage right to safety-enclosed unit substations at load centers—and the complete, permanent electric power system can be installed in less than one-third the time required to select and install piecemeal equipment.



11 All units are safety-enclosed to assure permanent safety to both personnel and production.



12 The breaker units of all switchgear equipments are easily removed for quick, easy inspection.

COPPER—When you replace heavy-copper secondaries with small-size primary cables, you save copper by the ton. Consider a 1000-kva, 4160/480-volt unit substation: For every foot that it is moved closer to the load center, you use 1.23 pounds of copper instead of 13.89 pounds. With many units and hundreds of feet, the copper savings soar.

You save copper within the units themselves, too. A typical unit of metal-clad switchgear uses only one-third the copper required by an open-type, piecemeal assembly for the same job.

TIME—In addition to the weeks you save by ordering safety-enclosed load-center units early, you save time by getting standards instead of specials—in a package instead of piecemeal. You avoid the preparation of detailed specifications, and long, drawn-out correspondence, when you select standard, co-ordinated units. You also save time installing the compact, easy-to-handle units.

THEY ARE IDEAL FOR TODAY - - AND FOR TOMORROW

SAFETY AND DEPENDABILITY—Metal-enclosure of all live parts gives increased protection to both personnel and continuous high production in today's busy factory areas.

EASY INSPECTION—Load-center unit substations include drawout-air-breaker equipments that control and protect the individual low-voltage feeder circuits, and quickly restore service with a turn of a handle. The individual breakers can be easily withdrawn for inspection. Similar breaker units are completely interchangeable, so any breaker can be replaced with a spare in a few minutes.

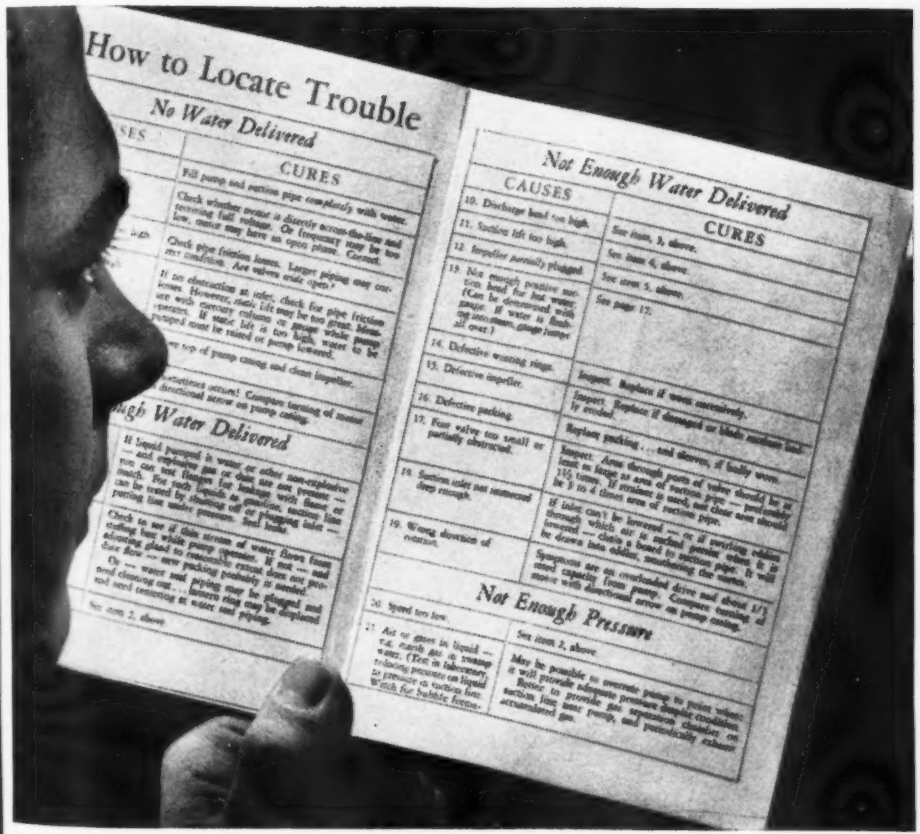
The higher-voltage, metal-clad switchgear equipments (photos 3, 4, and 5) have vertical-lift breaker units that are similarly easy to remove and to replace with a spare during periodic inspection.

FLEXIBILITY—Safety-enclosed load-center units "go anywhere the load can." Their compactness makes them easy to move, too—whether it be a few feet or miles. This flexibility is valued highly by many engineers who realize that they may want to move power units to follow shifting, changing loads.

GENERAL ELECTRIC

Schenectady, New York

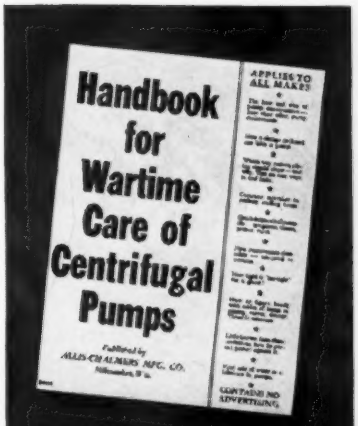
Sure Cure!



Contains no advertising—applies to all makes — copies mailed free of charge. Suggestion: this new book is particularly helpful for training new men to make present pumps last. When you *do* need new pumps, take a good look at the extra efficiency, ruggedness and long life built into Allis-Chalmers centrifugal pumps . . . all types for every purpose.

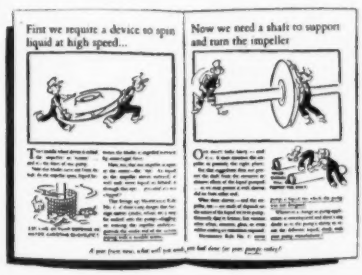
ALLIS-CHALMERS
MILWAUKEE

WE WORK FOR VICTORY — WE PLAN FOR PEACE



—AND KEEPING PUMPS OFF THE SICK LIST ISN'T SO EASY TODAY ...NOW THAT MANY ARE DOING 3 AND 4 TIMES THEIR NORMAL WORK!

EVERY "PUMP DOCTOR" in the U.S. should have a copy of Allis-Chalmers' *new* centrifugal pump maintenance guide handy these days. Reason: what was good pump care as recently as 1941 just isn't good enough for 1943. Pumps are working overtime, they're harder to replace — and war production can't afford delays caused by pump failure!



Because wartime pump problems are *new* problems, Allis-Chalmers' new handbook takes a *fresh* look at pump maintenance. A pump is built on paper to review its anatomy. You'll find new preventive maintenance tips, a guide to spotting trouble, new tables. Send in today for *your* free copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive free of charge a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

(Name)

(Title)

(Company)

((Street Address)

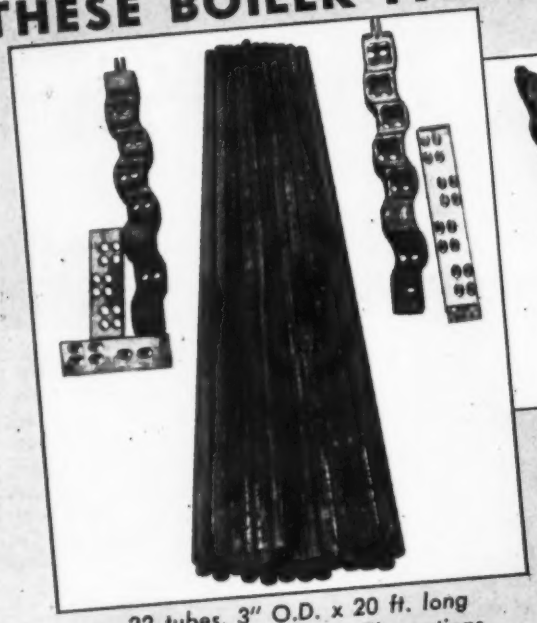
(City and State)

A-1584-1

REDUCE BOILER

Speed up job completion

THESE BOILER PARTS ARE SHOP ASSEMBLED INTO ONE SECTION!



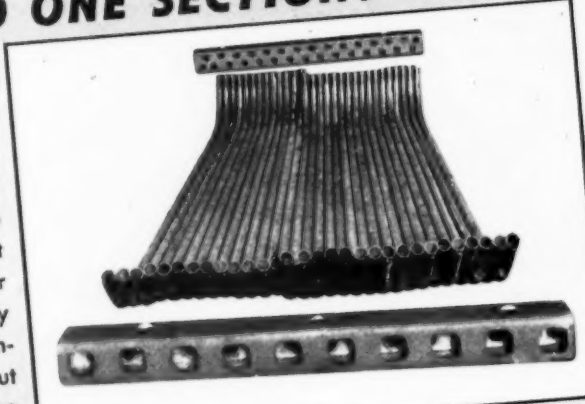
22 tubes, 3" O.D. x 20 ft. long
2 boiler headers, 3 baffle sections

3500 lb. boiler section

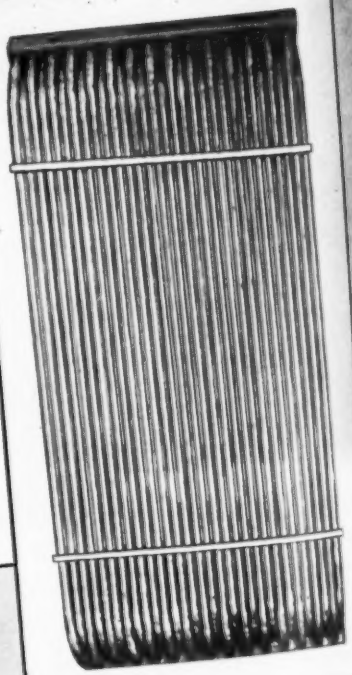
Sectional header design makes possible shop assembly of even the largest units. A double row of tubes in each section insures necessary sturdiness for shipping. No re-rolling of joints necessary in the field.

THESE WATER WALL PARTS ARE SHOP ASSEMBLED INTO ONE SECTION!

Springfield close spaced water walls, because of the close tube spacing and double row of tube connections to each header, are readily assembled into sections sturdy enough to withstand shipping without damage. The size of water wall sections is determined by shipping limitations and conditions at site of erection, but sections may nearly always be 9 ft. wide and often 10 ft. wide.

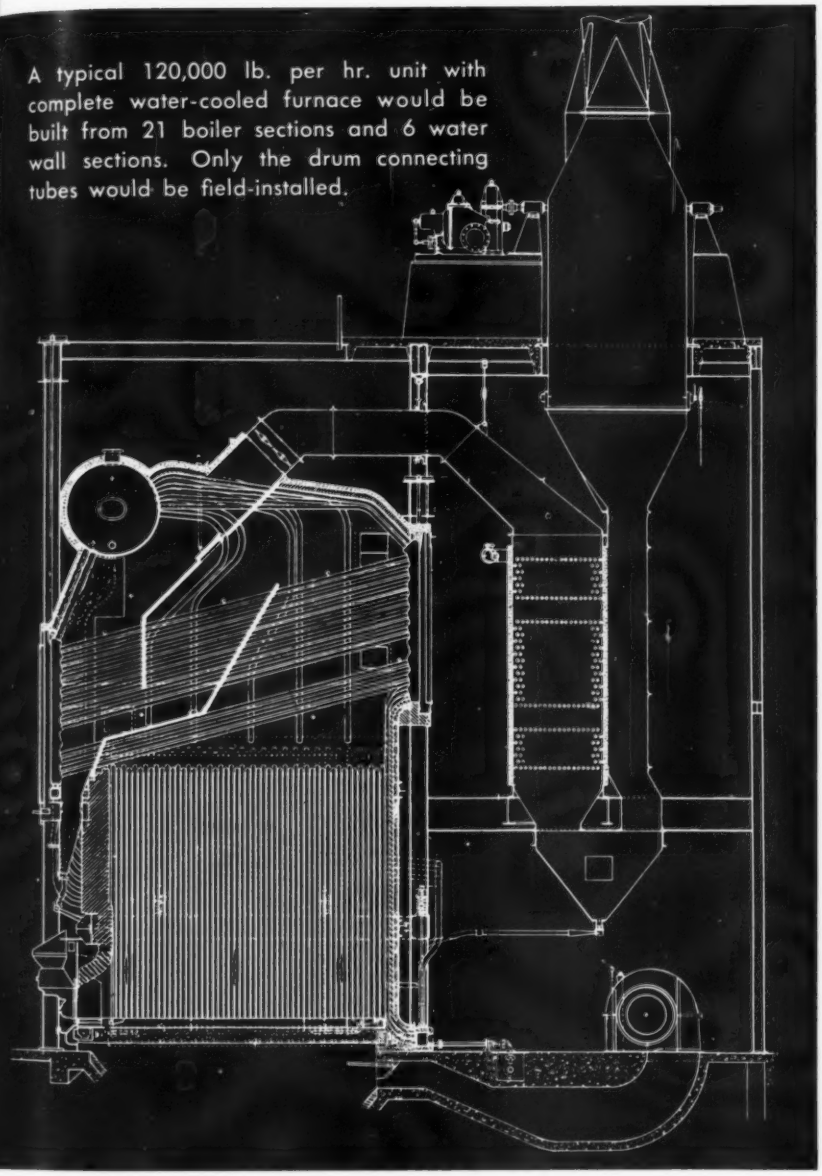


30 tubes, 3" O.D. x 22 ft. long
2 water wall headers



5200 lb. water wall section

ERECTION TIME... *with* SPRINGFIELD SHOP ASSEMBLED SECTIONS



A typical 120,000 lb. per hr. unit with complete water-cooled furnace would be built from 21 boiler sections and 6 water wall sections. Only the drum connecting tubes would be field-installed.

THE advantages of Springfield boiler design have never been more valuable than today, when getting war plants into production in the quickest possible time with the least possible labor is so essential. The fact that Springfield water walls and boiler sections are shop assembled offers you these important advantages:

TIME SAVING IN THE FIELD — As many as 30 to 60 days can be saved on boiler erection time according to actual records.

BETTER WORKMANSHIP — Shop assembled sections have the benefit of all necessary tools and facilities as well as experienced, competent workmen, neither of which are always available in the field.

LESS LABOR REQUIRED — Fewer skilled men and less man hours are required for Springfield boiler erection.

Write to Springfield today for complete information on boilers for your requirements. Any size, any pressure. Also a broad range of possibilities on *duplicate units* to meet your needs. SPRINGFIELD BOILER CO., 1953 East Capitol Avenue, Springfield, Illinois.

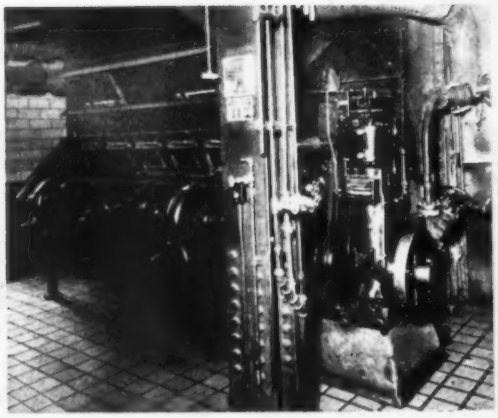
SPRINGFIELD

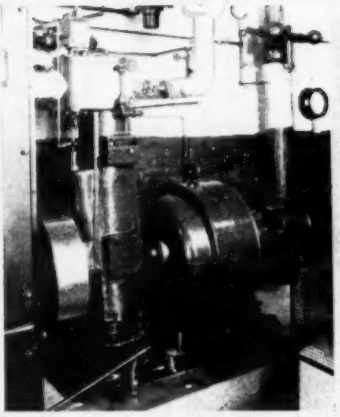
STEAM GENERATING UNITS

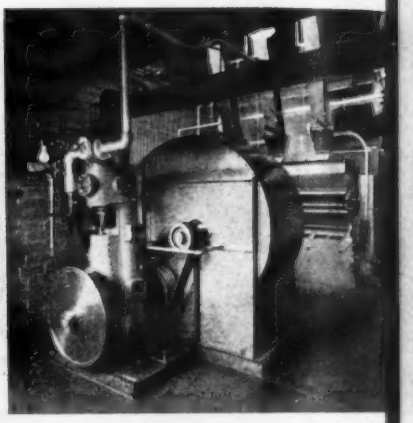
SPRINGFIELD BOILERS

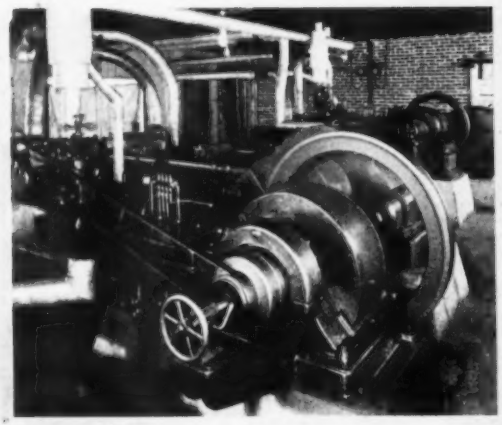
ANY SIZE ANY FUEL ANY PRESSURE

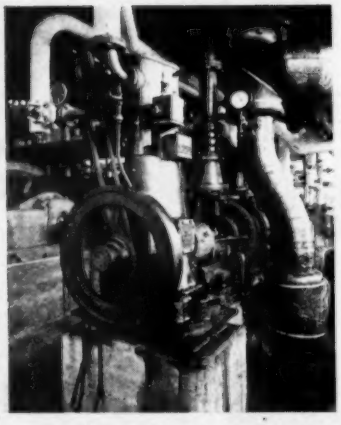
TROY-ENGBERG

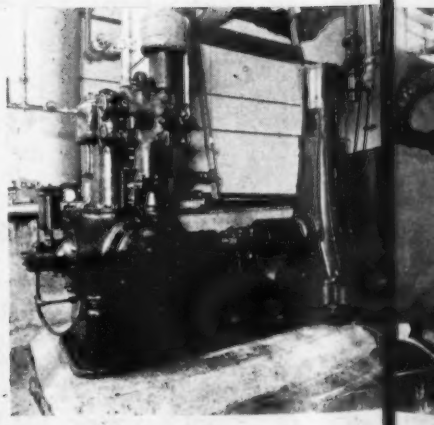












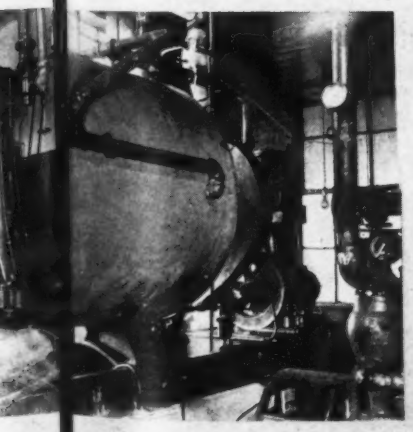
TROY-

STEAM ENGINE

Increases usefulness of existing boiler capacity by making steam do double duty

ARE you faced with this problem . . . more power needed but the boiler cannot be enlarged or the cost of purchased power would be more than you feel you can pay?

Possibly you can find the answer to your problem in a Troy-Engberg Steam Engine. This modern drive will operate on the live steam you are using for processing or heating, extracting but a very small proportion of the heat units in the steam. In other words, the steam does double duty—provides power on its way to producing heat!



Such power is called "by-product power" . . . and it is usually very low cost power. Hundreds of Troy-Engberg Steam Engines have paid for themselves in less than a year. Many hundreds more in a little over a year. Savings are usually very substantial.

A Troy-Engberg Steam Engine will provide the additional power you need for driving boiler room or manufacturing equipment and provide it at a very low cost.

TROY ENGINE & MACHINE CO.

Established 1870

1485 Railroad Avenue — Troy, Pennsylvania

Y-ENGBERG STEAM ENGINES • • • GENERATING SETS

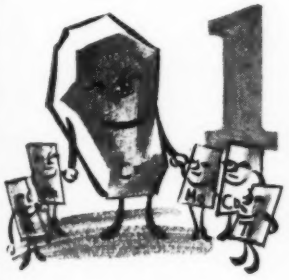
4-TEM-1

THERE'S CLEAN COOL WATER
RIGHT UNDER YOUR PLANT
...and a WORTHINGTON TURBINE WELL PUMP will deliver it to you as needed
Water Lubricated Type
Oil Lubricated Type
Either as a main or auxiliary source of water, a Worthington deep well installation offers many advantages attractive to far-sighted management. The assurance of a reliable supply of pure water, independent control in emergencies, approximately uniform low temperature throughout the year... all important points in long-range economy.
Products of the world's largest pump builder, Worthington turbine well pumps incorporate developments in construction and materials that are based on a century of hydraulic experience and on successful installations in virtually every industry.
• A type and size for every requirement... up to 15,000 gallons per min., 700 ft. head, 1000 horsepower.
• Open or closed lineshaft... water-lubricated or oil-lubricated.
• Designed for low-cost operation... minimum friction, full-streamlined water passages.
• Rugged construction... with plus-features that add years of service.
• All types of drive... electric motor, steam turbine, diesel or gas engine, flat-belt or V-belt.
» Write for large-size cross-sectional chart showing details of important mechanical and hydraulic features.
MEMBER
DW3-2
WORTHINGTON
WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

Basic Facts about

STAINLESS STEELS

A STAINLESS STEEL PRIMER



STAINLESS STEELS

are corrosion-resistant steels containing at least 12 per cent chromium with or without other alloying elements, such as nickel, manganese, molybdenum, columbium or titanium. They are supplied in a wide range of analyses.

The stainless steels vary in corrosion resistance, workability, wear resistance, and physical properties according to the amount of chromium, carbon and other modifying elements present.

VALUABLE PROPERTIES INCLUDE:

Good corrosion and oxidation resistance . . . varying almost in direct proportion to the amount of chromium present.

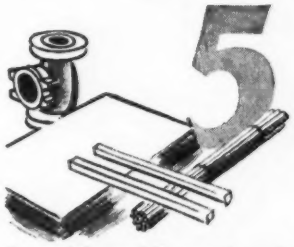
High strength-weight ratio in some cold-rolled types permitting fabrication of strong, light-weight trains, aircraft, and other structures.

MAINTENANCE

of stainless steels is simple. Washing with soap, water, and a cleanser recommended for stainless steel will keep the surface bright and free from surface deposits.

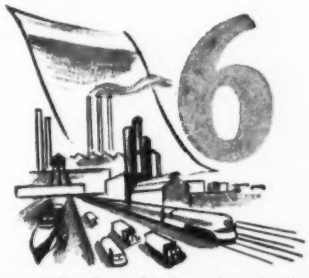
FABRICATION

is accomplished by almost all common methods. They can be machined, spun, deep-drawn, forged, punched, stamped, and otherwise mechanically-worked. They can be welded by all the common welding methods. If the austenitic steels are stabilized with columbium or titanium, and columbium-bearing welding rod is used, no annealing is necessary after welding.



MANY FORMS

are available in the common analyses including sheet, plate, strip, tubing — both seamless and welded — bars, wire, cable, welding rod, and a variety of cold-rolled shapes. Stainless steel is also supplied as foundry castings.



APPLICATIONS

of stainless steel are numerous. Because of their resistance to corrosion and oxidation, as well as their high strength and bright surface, stainless steels have been used in hospitals, chemical plants, oil refineries, railroad trains, aviation equipment, and power plants. In the present emergency, they are available only for those industries participating in war production.

• • •

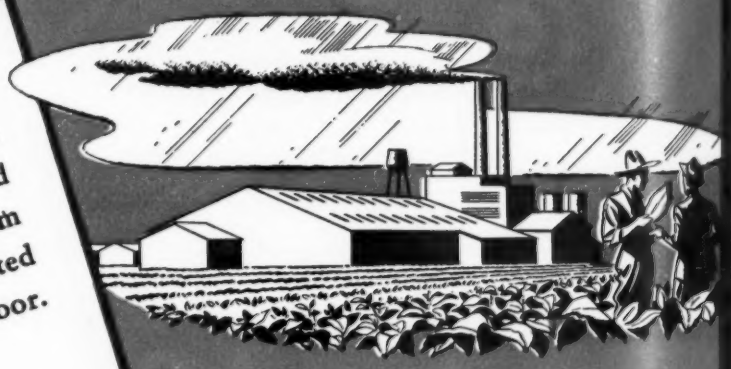
Although we do not make steel, we have for more than 35 years produced "Electromet" ferro-alloys and metals used in making steel. With the knowledge accumulated from this experience, we are in a position to give impartial advice. If you have a specific problem concerning the manufacture, fabrication, or use of stainless or other alloy steels, consult us without obligation.

Electromet
Trade Mark
Ferro-Alloys & Metals

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York, N. Y.
In Canada, Electro Metallurgical Company of Canada, Limited, Welland, Ontario.

VHEN PERFORMANCE COUNTS
YOU CAN COUNT ON
A-E-CO TAYLOR STOKERS

A CASE IN THE TOBACCO INDUSTRY



ROBLEM:

The situation at this plant was unusual. Firing equipment had to be selected which, burning the widest range of coals economically available, would operate at maximum efficiency with a minimum furnace volume. The existing plant was of limited height and had no basement below the firing floor.

SOLUTION:

Upon due consideration of the requirements, a Taylor Continuous Ash Discharge Stoker was installed under a 70,000 lb. per hour steam generator. No heat recovery equipment was purchased.

RESULTS:

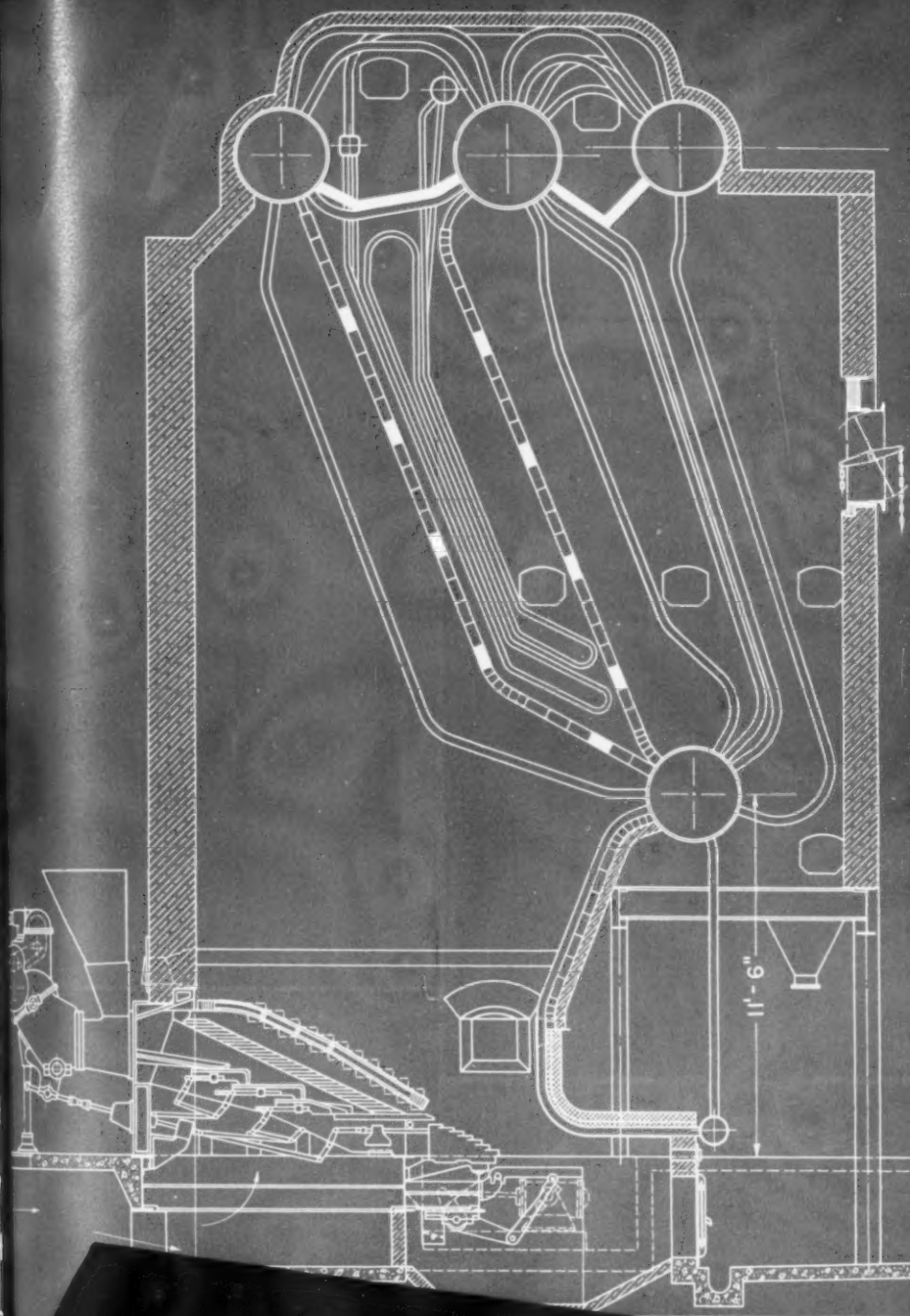
The unit was placed in service March 24, 1940. A recent report on performance from that date until April 30, 1942 disclosed 442,884,000 lbs. of steam generated from 45,311,280 lbs. coal (average evaporation; 9.77 lbs. steam per lb. of coal). The coal contained an average content of 13,890 B.T.U. per lb. as fired. Operating conditions; 410 lbs. pressure, gauge; 650°F. total steam temperature; 277°F. feed temperature to boiler. The combined efficiency of the unit was 79.9%. It is interesting to note that the unit was in service 17,448 of the elapsed time of 18,432 hours, or available 94.6% of the time.

CONCLUSIONS:

This case demonstrates two important advantages of the Taylor Stoker—its ability to burn a wide range of coals economically and the ease with which it can conform to limitations of space. By eliminating the need of new construction, the space advantage of the Taylor Stoker contributes to conservation of essential materials.

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA



A-E-CO TAYLOR STOKERS ON THE FIRING LINE

*Aluminum Company of America #1
*Aluminum Company of America #2
American Tobacco Co., Inc., Durham, N. C.
Cannanes Paper Company
Chrysler Corporation, DeSoto Plant
*Collins and Aikman Corp., Roxboro, N. C.
City of Columbus, Ohio
*Consolidated Paper Company
*Cresson State Sanitarium, Cresson, Penna.
Defiance Milk Products Co., Defiance, Ohio
*DeLaval Steam Turbine Co.
*Detroit Sulphite Pulp & Paper Co.
City of Dover, Ohio
*Draper Corporation
Erwin Cotton Mills Co.
*Fisher Body Corporation #1
Fisher Body Corporation #2
*Fisher Body Corporation #3
*Fisher Body Corporation #4
Fox Paper Company
Froedtert Grain and Malting Co., Milwaukee, Wisc.
*City of Galion, Ohio
*Gardner-Richardson Company
*General Electric Company #1
*General Electric Company #2
*Greenwood Electric L. & W. Plant
*Board Public Works, Hannibal, Mo.
Hill School, Pottstown, Penna.
*Hobart Mfg. Co.
*City of Holland, Michigan
*Hope Natural Gas Co.
Hudepohl Brewing Co., Cincinnati, Ohio
Industrial Cotton Mills
*City Water & Light Plant, Jonesboro, Ark.
Kohler Company
Maryland State Penal Farm, Roxbury, Md.
*Maybury Sanitarium, Northville, Michigan
Michigan Carton Company, Battle Creek, Michigan
*Michigan State College, East Lansing, Mich.
Municipal Light Plant, Marshfield, Wisc.
*Pacific Mills
*Packard Motor Car Co.
*Municipal Electric Plant, Painesville, Ohio
*Park Drop Forge
*Pennsylvania Electric Co.
*Pennsylvania R. R. Co., Philadelphia, Penna.
*Pittsburgh Plate Glass Co.
Borough of Quakertown, Quakertown, Penna.
Raleigh Wyoming Mining Co., Glen Rogers, W. Va.
*Rhinelander Paper Company
City of Richland Center, Wisconsin
*City of Richmond, Indiana
Sayles Biltmore Bleachery, Biltmore, N. C.
Scotten Dillon Company
Shelby Cotton Mills
Sloane-Blabon Corp.
*Solvay Process Company
*St. Elizabeth's Hospital, Washington, D. C.
City of St. Bernard, Ohio
Swarthmore College, Swarthmore, Penna.
*Timken Roller Bearing Co. #1
Timken Roller Bearing Co. #2
Municipal Water & Light Plant, Tippecanoe City, O.
City of Toledo, Ohio
*Union Bleachery, Greenville, S. C.
Union Mills Paper Mfg. Co.
*University of Wisconsin, Madison, Wisc.
*Vassar College, Poughkeepsie, New York
*Borough of Vineland, New Jersey
Warfield Natural Gas Company, Harold, Kentucky
White Sewing Machine Co.
Whiting Plover Paper Company

(*) *Represents repeat orders.*

A-E-CO TAYLOR STOKER

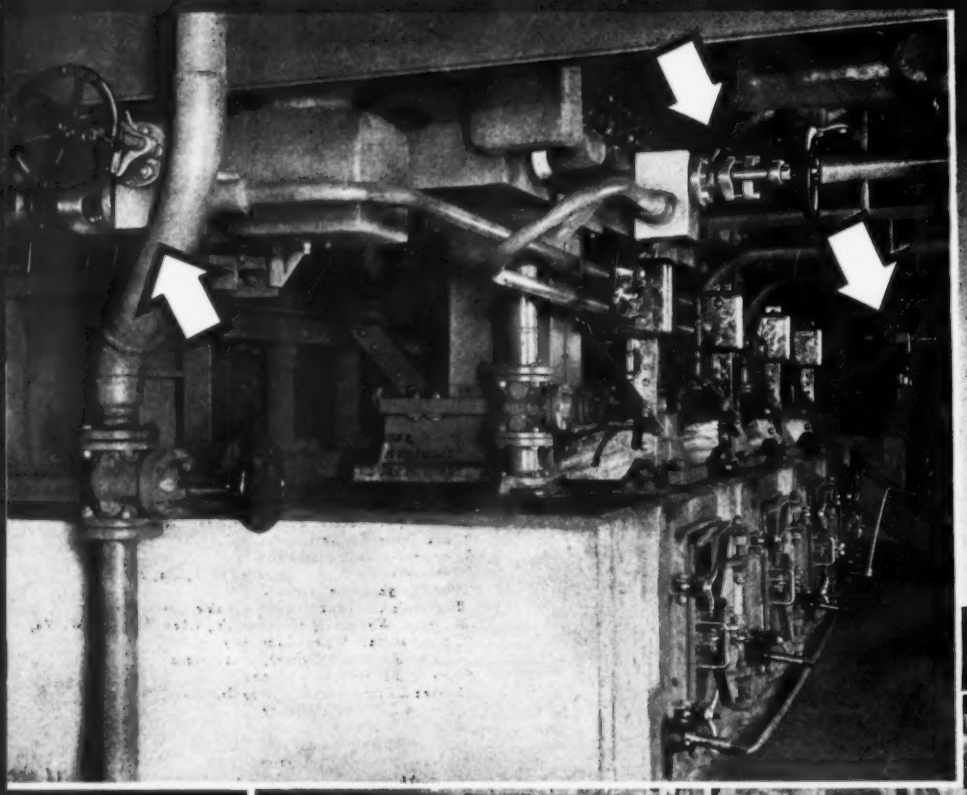
A-E-CO TAYLOR STOKERS
WATER WALLS · ASH HOPPERS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES
LO-HED HOISTS

COMPANY

ARE YOU JUDGING YOUR STOKER BY THESE TWELVE POINTS?

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of pow service demands.
8. **FUEL FLEXIBILITY**—the ability to burn eff ciently and easily fuels from many source having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economi cally eliminate ash or refuse and the opportun ties of disposal at low cost, no cost, or profi
10. **STACK DISCHARGE**—the practical elimin tion of "smoke nuisance" without speci equipment.
11. **SPACE REQUIREMENTS**—the ability to co form to existing or future space limitations, short and wide or long and narrow furnace Also the accessibility of component parts f maintenance and operation.
12. **OBSOLESCENCE** — the adaptability of t equipment toward possible future moderniz tion with minimum of complication and outag

YARWAY



Above: Yarway Unit Tandems on Water Wall Drains at West Reading Station of the Metropolitan Edison Co. There are 4 sets of these Tandems used—two sets on each of the two Boilers in the New Addition to this plant. These valves are used to drain the water walls only when the installation is periodically shut down for maintenance.

Below: Two of the four sets of Yarway Unit Tandems on the two new Boilers at West Reading Station. These valves are used to blow down the lower drums about once per week.

YARWAY

at West Reading

Yarway Unit Tandem Blow-Off Valves Serve this 1400 lb, 900° Station Addition

ANOTHER in the long list of modern high pressure generating stations to select Yarway Unit Tandems for both water wall drains and boiler blowdown lines—the West Reading Station of the Metropolitan Edison Company. (Designing Engineers, Gilbert Engineering Co., Reading, Pa.)

Years of service in the highest pressure plants of leading utilities and industrials have proved the sound design and metallurgy of the Yarway Unit Tandem for blowing down or draining and sealing.

Such records as—"3000 blows at pressures of more than 1300 psi without a single replacement of parts or repairs of any nature"—have made this tandem the outstanding preference for high pressure blow off and draining service, today.

What are your draining and blowdown requirements? Write for Catalog. Section B-431 for pressures up to 2500 lb; section B-422 for lower pressures.

Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing and for sealing—in a compact, rugged unit.

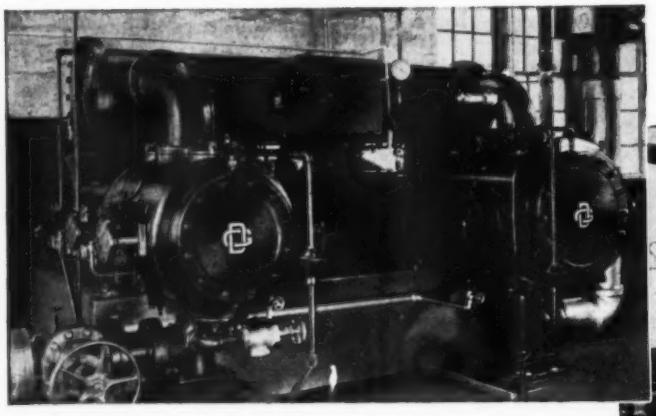
YARNALL-WARING COMPANY
100 Mermaid Avenue Philadelphia

BLOW-OFF VALVES

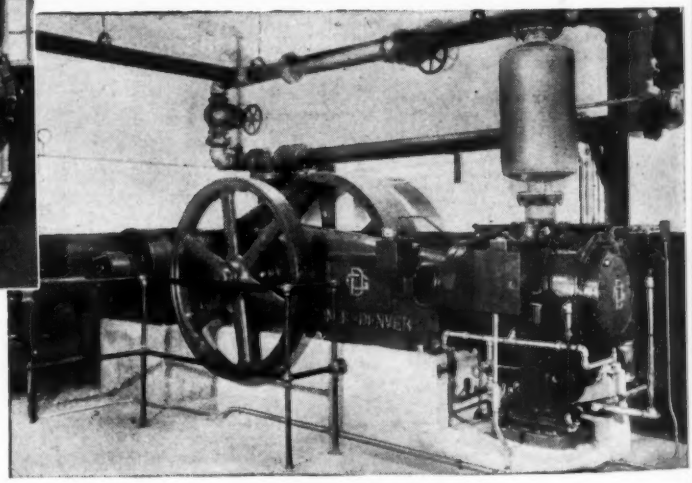
More POWER Behind Your Manpower!!

IN today's production battle, every man-hour counts for more when it's backed by plenty of power. Gardner-Denver Horizontal Compressors have long been famous as an ever-ready source of compressed air power. They're proving themselves under the grind of continuous operation in scores of war plants today—taking in stride the extra hours—the extra demands for air output.

Their dependable performance is based on such advanced design features as extra rugged frame construction . . . Timken roller main bearings . . . entirely automatic capacity control.



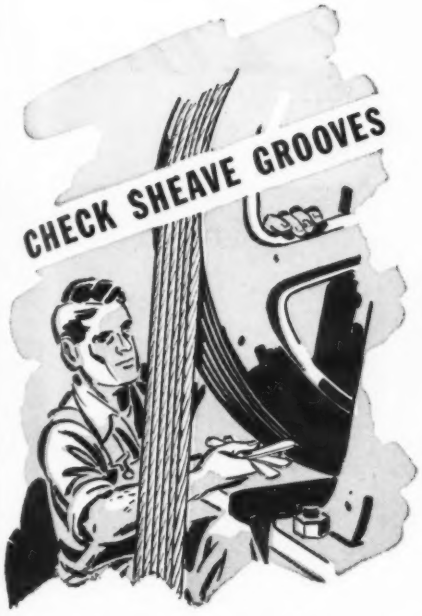
Engineered for continuous heavy-duty performance—the Gardner-Denver "HA" Two-Stage Horizontal Air Compressor is built in capacities from 468 to 1854 cubic feet displacement per minute.



Designed for unusually low horsepower requirements—Gardner-Denver "RX" Single-Stage Horizontal Air Compressors are built in capacities from 89 to 1292 cubic feet displacement per minute.

Write for bulletin giving complete information on Gardner-Denver "HA" Two-Stage and "RX" Single-Stage Horizontal Air Compressors. Gardner-Denver Company, Quincy, Illinois

GARDNER-DENVER *Since 1859*

COMBAT ORDERS FOR YOU

IF YOU'RE FIGHTING *CABLE WEAR*

No need to tell you why there isn't as much steel as usual for replacing worn elevator ropes. But we can help keep those you have on the job for the duration. FIRST: Get a copy of the Roebling Elevator Rope Tag "C" for each of your maintenance men. It's a convenient way to remind them about proper care and handling. SECOND: Consider the other vital points covered below. They may suggest a practical way to make sure you get every hour of *extra* service that has been built into your Roebling "Traction Steel" Ropes.

SHEAVES—Check to be sure that all ropes seat to the same depth in the grooves...regroove if excessively worn. Check for bearing wear that throws sheaves out of line...and see that bearings are well lubricated.

BRAKES—Check for wear on brake linings that may be causing jerky stops and straining your ropes unnecessarily.

SPEEDS—Check whether car speeds are too high for operators to stop consistently at floor level the first time. A difference of a hundred feet a minute may be all that is necessary.

SCHEDULE—Check with starter on average between-rush-hour load. Change schedule if necessary to carry more passengers per trip, fewer waste loadings.

Remember, yours is a job of keeping war traffic moving. The steel that you save by conserving elevator cables is needed for the fighting fronts.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY
Branches and Warehouses in Principal Cities

ROEBLING
"Traction Steel"
ELEVATOR ROPE

Boiler Outage Time

Republic

ELECTRUNITE*

REPUBLIC STEEL — PRODUCTION FOR VICTORY

*Reg. U. S. Pat. Off.

CUT DOWN

WITH TUBES THAT GO IN QUICKLY AND STAY IN A LONG TIME....

•Republic ELECTRUNITE Tubes do that!

They go in quickly—save installation time—because they are consistently uniform in diameter, wall thickness, concentricity and ductility. They slide through holes in tube sheets and drums easily. They roller expand and bead over evenly and rapidly to tight, "non-weeping" joints. They weld readily. Time saved is indicated by reports from users of up to 30% saving in installation costs.

Then, once installed, ELECTRUNITE Tubes stay in a long time—give the extended, trouble-free service needed in heat-generating or transfer equipment, especially today.

These tubes are uniformly strong—equally as strong in weld as in wall. Countless tests have proved this fact. Reports from boiler authorities verify it. And ten years of proof afforded by millions of feet in service further substantiate it.

Republic ELECTRUNITE TUBES gain these advantages from the process and *CLOSE CONTROL* of their manufacture—the *most advanced* method of electric resistance welding tubing.

And because these tubes are fabricated cold, they offer another important advantage. They are smooth—free from corrosion-inviting scale and scale pits.

Unnecessary outage time helps no one—except the enemy. Write us for further information.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
Sales Offices • Cleveland, Ohio
GENERAL OFFICES • CLEVELAND, OHIO
Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Union Drawn Steel Division
Truscon Steel Company
Export Department: Chrysler Building, New York, New York

ELECTRIC RESISTANCE WELDED BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Testing in the Shop that is TIME SAVING In the Field

Piping that is pre-fabricated in any of the Midwest shops is carefully inspected and subjected to the most searching tests . . . . tests for which it was necessary to design and build considerable special equipment. This is representative of the care given every detail of Midwest Pre-fabricated Piping.

Also contributing to the saving of time in the erection of all Midwest piping sub-assemblies are the thorough cleaning and the checking to make sure dimensions and alignment are correct. In these days when time is frequently the most precious of all things, Midwest Piping Service is of even greater value.

MIDWEST PIPING & SUPPLY COMPANY, Inc.

Main Office: 1450 South Second Street, St. Louis, Mo. • Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St.
New York—(Eastern Division) 30 Church St. • San Francisco—535 Call Bldg. • Tulsa—533 Mayo Bldg.

Garlock

"...if you produce 'em!"

"The production lines will determine whether we hold the battle lines," said Donald M. Nelson.

Our fighting men will "deliver the goods" if we'll produce them and transport them to the vital points where they are needed.

So it's up to us back home to exert every effort to supply torpedoes guns, ships,... everything our fighters need. Let's go, America!

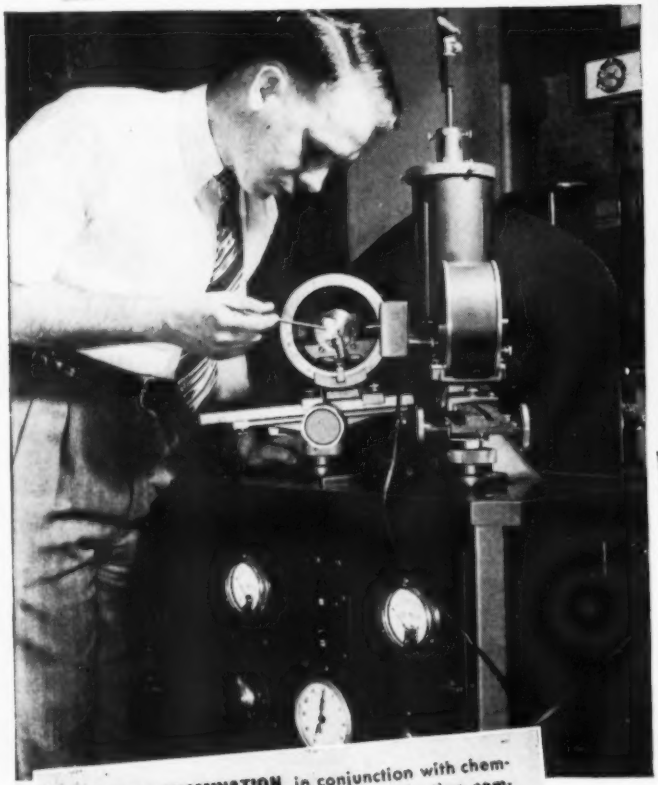
THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

How Hall Boiler Clinic

1 A CORNER OF HALL LABORATORIES' engineering service laboratory where boiler scales, sludges and waters are subjected to critical examinations.



3 X-RAY EXAMINATION, in conjunction with chemical analysis and microscopic examination, completes the work of identification.

4 THE METALLURGICAL MICROSCOPE becomes indispensable when metal structure must be studied to determine if damage was caused by overheating, corrosion fatigue or embrittlement.

5 SPECIMENS from embrittlement detectors in hundreds of plants are checked regularly for cracking, to determine the embrittling characteristics of the boiler waters.

safeguards the "steam front"!

2 THE POLARIZING MICROSCOPE which plays an important part, both in the identification of chemical compounds present in deposits and in the continuing Hall water-research program.

6 COMPLETE FILES give the case history of every Hall job. All reports from that of field service engineer to the final Hall recommendations are centered here for immediate reference.

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.

What these famous laboratories, expertly staffed and fully equipped, do to provide protection for America's power plants.

HAVE you ever heard of a boiler clinic? Well, there has been one in continuous operation ever since the beginning of Hall Power Plant Service. Its "out-patients" are the nation's industries. To its laboratories for diagnosis and remedy come the victims of scale, corrosion, carryover and embrittlement. In its files is the most unique collection of case histories in the world—the behavior record of countless boilers.

That is why the Hall field engineer approaches your need with such confidence. He knows that however difficult the problem he meets, if he can't solve it on the spot, the laboratories he represents can and will provide the correct technical answer.

The moment you become a Hall client this clinic starts functioning and your boiler's case history begins. Month by month, as the field reports come in, the story of the conditions you face builds up, the things you were helped to do to give you the right preventive care, the results you got from doing them.

To hundreds of Hall preventive-care clients the work of this clinic has long been a matter of simple routine—they haven't known an unscheduled boiler outage caused by water in years. They found, just as you would, that when the right things are done at the right time, most boiler trouble can be prevented.

Safeguarding the "steam front" has been our job ever since Hall specialists pioneered in this field. Today, it is one of the most vital contributions that can be made to America's productive effort. Why not write for full information?

HALL LABORATORIES, INC.

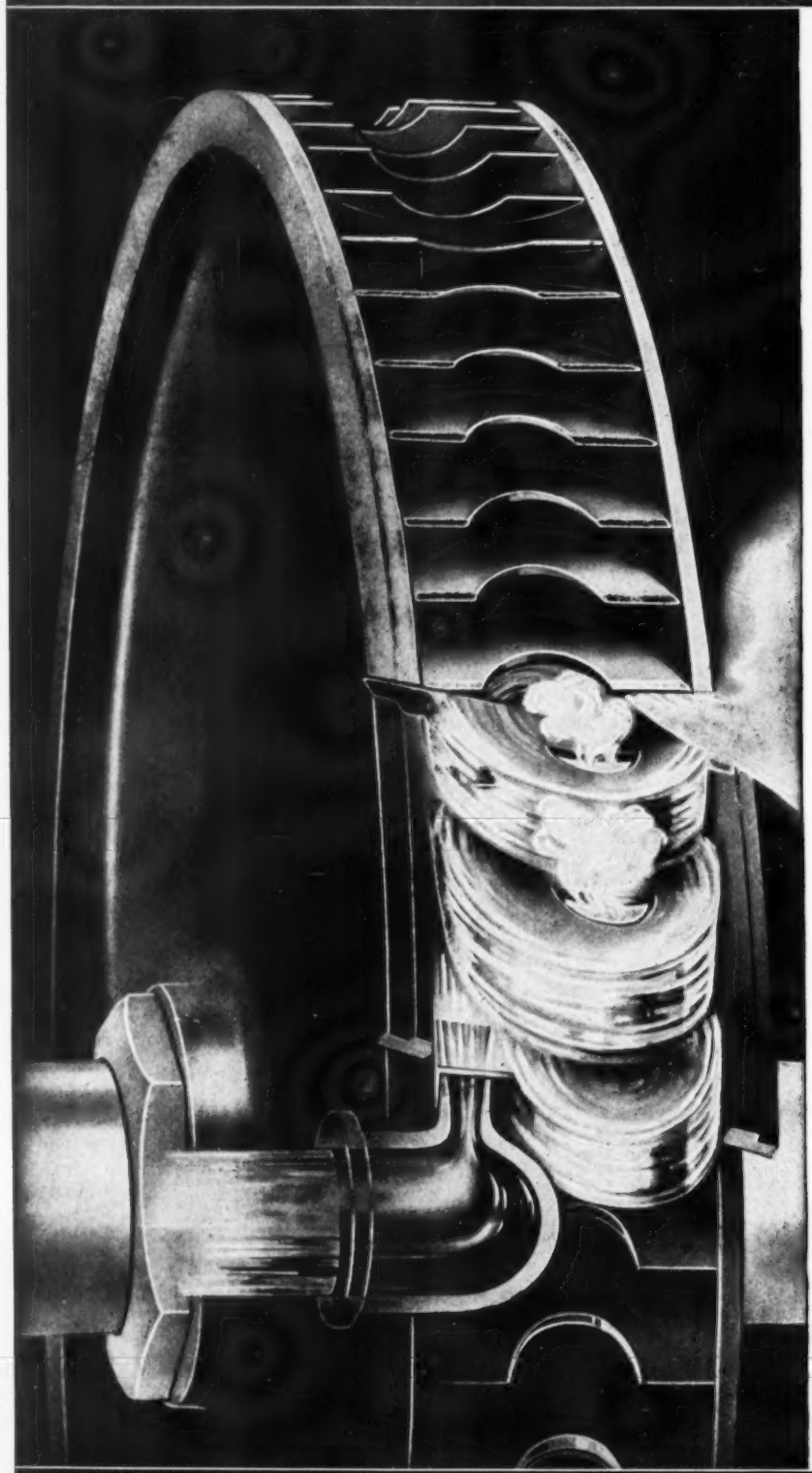
A subsidiary of Hagan Corporation

HAGAN BUILDING, PITTSBURGH, PA.

HALL SYSTEM
of Boiler Water Conditioning

HAGAN
HALL
BUROMIN
CALGON

The TERRY



RELIABILITY FIRST!

Throughout the entire forty-nine years that the Terry Turbine has been on the market it has always been the Terry policy to build first of all for reliability.

That this policy has been appreciated is proven by the very extensive use of Terry turbines where only the most trustworthy apparatus is permissible, namely in outstanding central stations, leading industrial plants and on large Naval vessels. The Terry today still maintains that preeminent position in these most exacting fields which it immediately took upon its introduction.

At Left:—

Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

THE TERRY STEAM TURBINE CO.

Wheel Turbine

STEPS IN THE MACHINING OF A TERRY TURBINE WHEEL — From left to right:
1. Rough turned forging. 2. Smooth turned. 3. First milling cut. 4. Second milling cut. 5. Finished wheel.

TERRY WHEEL TURBINE ADVANTAGES

— The blades and the wheel are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

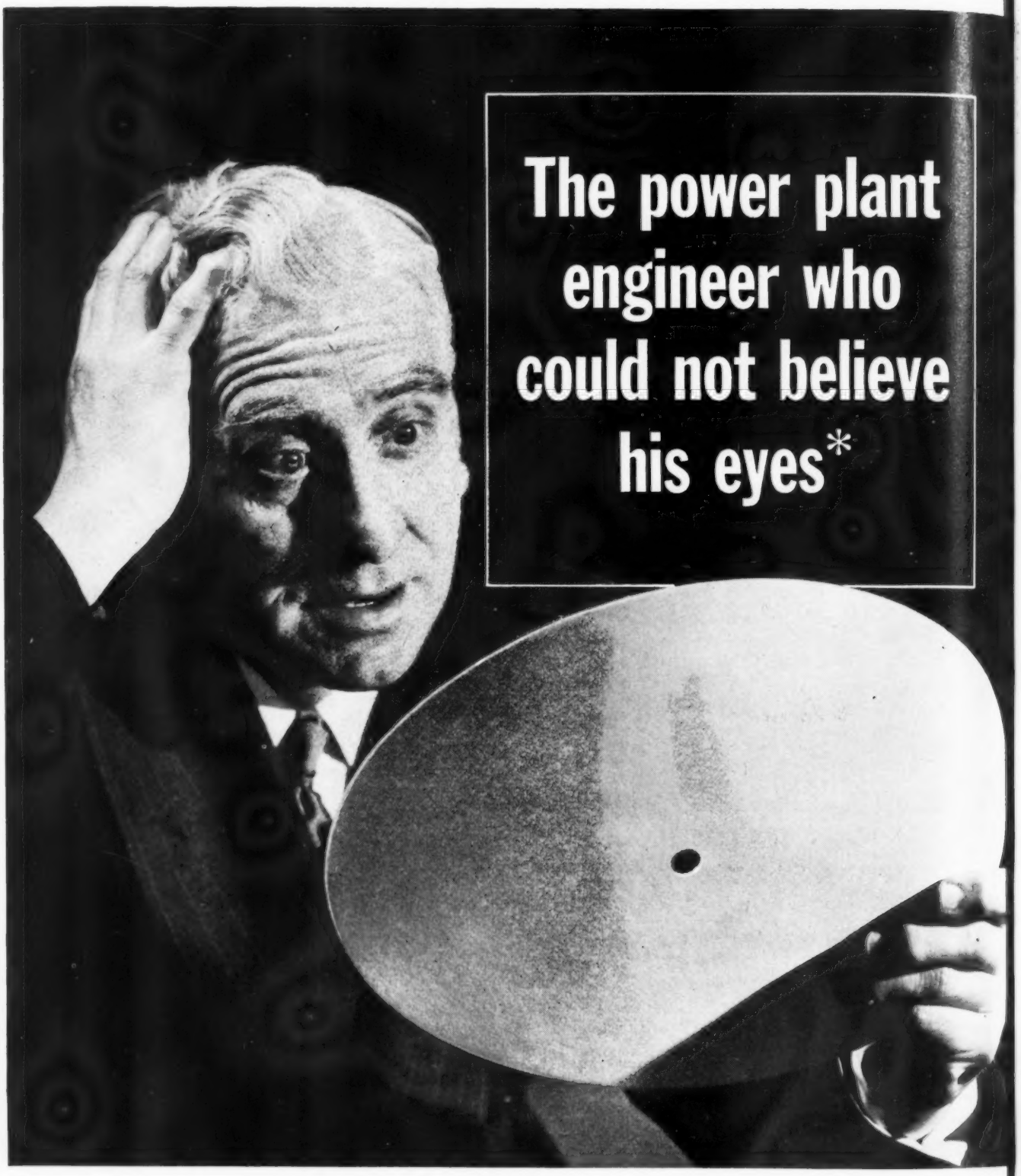
— The only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horse power or efficiency. The important part of the bucket is the back or bottom which is a solid forging.

— There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

ASK FOR BULLETIN S-116

T-1143

TERRY SQUARE - HARTFORD, CONN.



Things you should know about Hagan Control

Hagan engineers were the first to successfully introduce automatic combustion control.

And through 25 years of experience with this system they have been first to introduce many notable improvements since accepted as standard.

This fact alone is sufficient to justify an investment in Hagan. Regardless of other means employed, Hagan Control, by adjusting all auxiliaries for maximum output, will positively assure the maximum of steam from every pound of fuel.

*It was not his fault. . . It was his first experience with Hagan Control

We would not think of telling you where this incident occurred. But here is the story just as we took it from a Hagan engineer's call-report:

'A day or two after we put the pressure-reducing station in service, one of our men happened to be out in the turbine room and saw one of the turbine room engineers busily engaged in taking a pressure recorder apart. Our man asked him what he was doing and the chief engineer told him the gauge was stuck and he was fixing it. Actually what happened was that the steam pressure was held so closely by the Hagan Control that the engineer had obtained this false impression. There was nothing wrong with the gauge; it was only the fact that they had been used to seeing the pressure *vary all over the lot*, with previous hand operation of the old boiler. Now that the steam was coming from the new high-pressure boiler and through the Hagan Pressure-Reducing Valve, the recorder was drawing a perfect circle."

Experiences similar to this are becoming more and more common as new high-pressure boilers are being operated in conjunction with old, low-pressure boilers.

NOTE: When your new boilers go in service be sure that the pressure-reducing station and desuperheater are controlled by time-proven Hagan pressure-reducing equipment. Hagan Automatic Pressure-Reducing Systems are available to meet any operating conditions. Full particulars on request.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, PA.

HAGAN

Automatic COMBUSTION CONTROL

The pioneer. . . and still the leader

Count the specific advantages Hagan superior engineering offers:

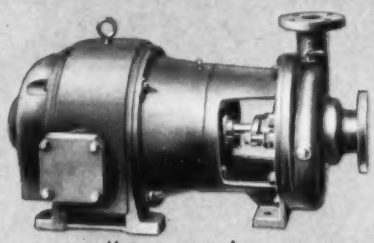
1. Simplicity of operation.
2. Ruggedness of equipment.
3. Sensitivity to small load changes.
4. Accuracy of adjustment for small variations.
5. Speed of movement, with stability, throughout operating range.
6. Flexibility in meeting individual plant conditions.
7. Ease of installation.

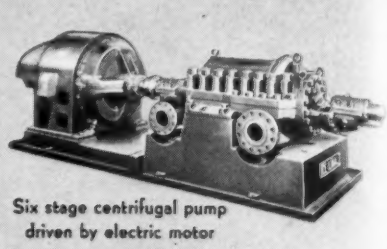
For further evidence of Hagan leadership look to the thousands of installations throughout industrial America which year in and year out perform with unqualified efficiency.

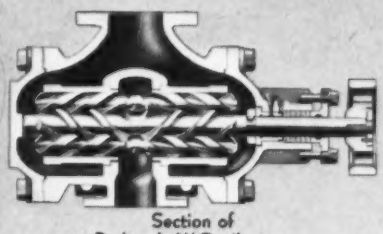
An investment to meet today's needs for increased steam capacity which will pay rich dividends in the tomorrows to follow.

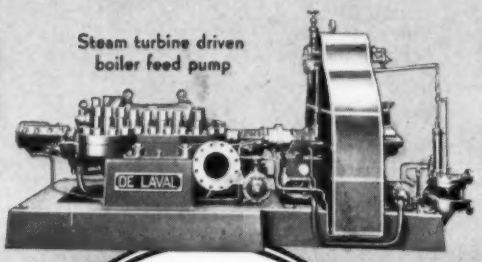
HAGAN
HALL
BUROMIN
CALGON

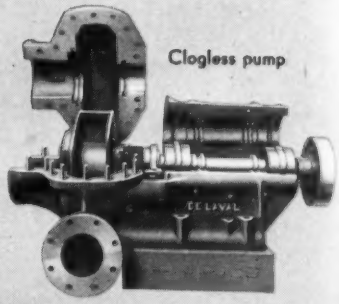
Single stage, double suction pump with motor drive

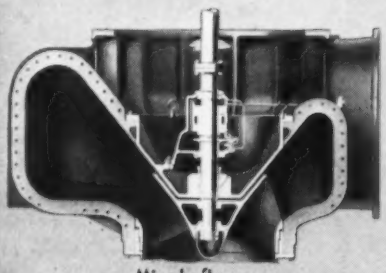

Motor-mounted pump


Six stage centrifugal pump driven by electric motor

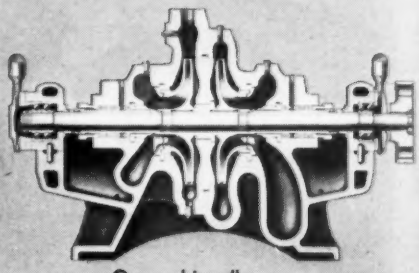

Section of De Laval-IMO oil pump

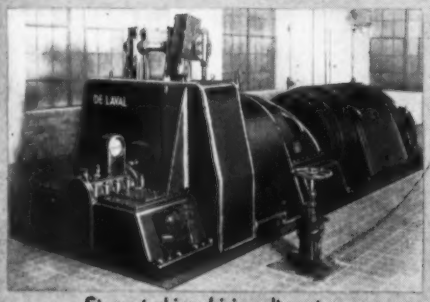

Steam turbine driven boiler feed pump

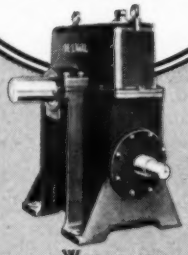

Clogless pump

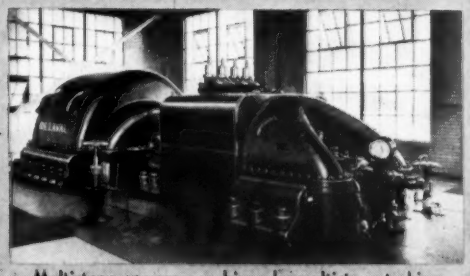

Mixed-flow pump

DE LAVAL *Products*

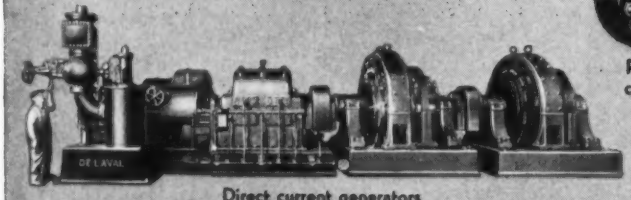

Opposed impeller pump

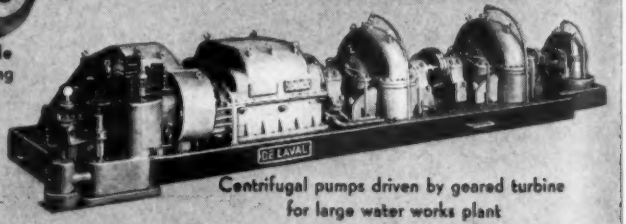

Steam turbine driving alternator


Worm gear


Multistage compressor driven by multistage turbine

Flexible coupling


Direct current generators driven by geared turbine


Centrifugal pumps driven by geared turbine for large water works plant

State requirements so that appropriate catalog may be sent.

3228

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POWER

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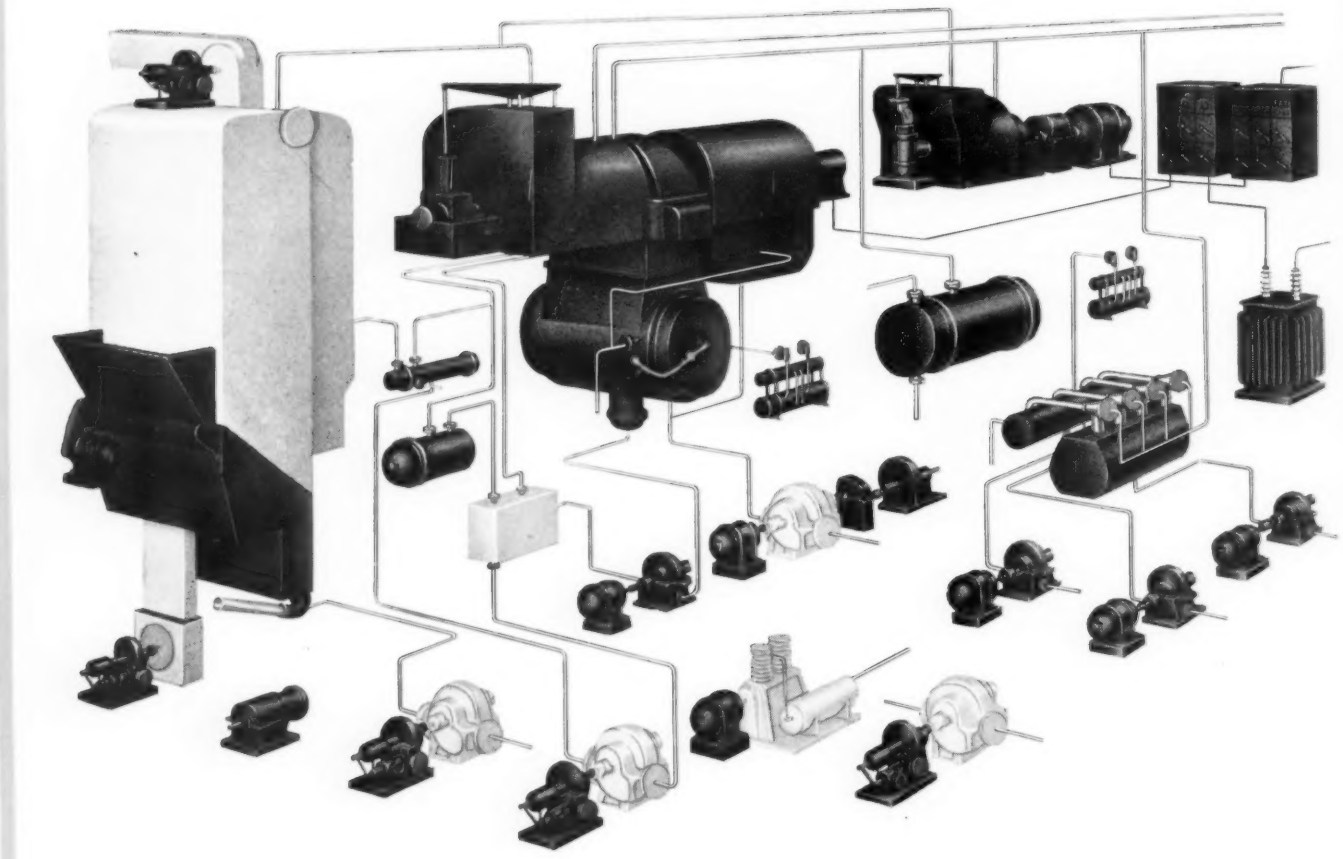
"Power Plant Auxiliaries"



for your equipment library...

Copies of any of these publications will be sent to you on request. You'll find them useful, factual—worth-while additions to your library of information on power equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

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this unit-responsibility will speed selection and installation of auxiliary equipment

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A glance at the chart shows that Westinghouse supplies a surprisingly large proportion of all power plant equipment—as much as 65%, to be specific. (Westinghouse equipment illustrated in darker color.) Each one of these varied products incorporates in its basic design the combined thinking of product specialists and steam plant engineers. Modern steam practice demands close co-ordination and a high degree of reliability in auxiliary equipment. To get all the benefits of modern steam practice — it will pay you to see Westinghouse first.

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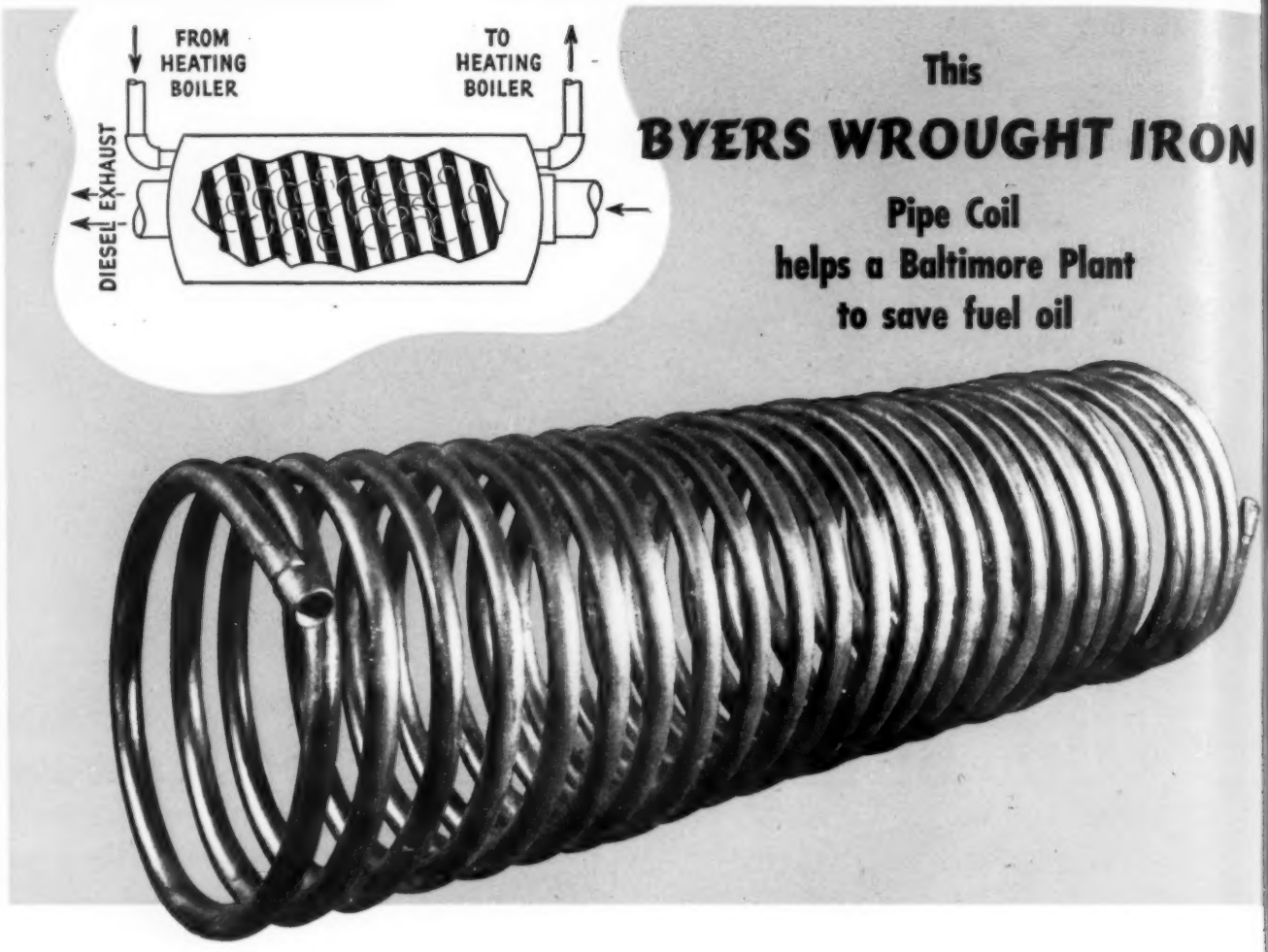
WESTINGHOUSE



This BYERS WROUGHT IRON Pipe Coil helps a Baltimore Plant to save fuel oil

Fuel conservation is always good business, and in times like these, it's essential business. Any original methods are definitely news.

When the oil quota of Baltimore Cold Storage Company was cut 50%, J. C. Lieb, president, devised a way of supplementing this meagre supply with heat reclaimed from Diesel exhausts.

He turned the job over to John H. Zink, president of Heat and Power Corporation. Mr. Zink, because of his knowledge of the corrosion resistance, bendability and excellent welding qualities of Byers Wrought Iron, used it in fabricating the pipe coil illustrated. It was cold bent around a short piece of 14-inch OD pipe, and the joints welded. The coil was then installed in a tank shell, through which the Diesel exhaust passed. Connected to the regular heating boiler, the coil serves as a preheater and auxiliary. Experience to date indicates that with its help, the heating load can be carried on the fuel oil rationing allotment. The last report was, "Heater coil working out to entire satisfaction of all concerned."

As is to be expected, plant engineers are showing a lot of resourcefulness in solving emergency problems. In many cases, they are finding wrought iron an invaluable assistant, for it is not enough today just to make things *work;* you have to make them *last.*

If you have any problem in connection with new or old equipment or services, where severe corrosion or vibration that might cause fatigue are present, don't select materials without giving careful consideration to wrought iron. It has been used for practically every application in the average plant, and so its performance is not a matter of guess work, but of engineering record. These records, received from practical engineers like yourself, are a big help in writing sound specifications, and are at your service; just write, outlining your particular problem. Ask, too, for a copy of our technical bulletin, "101 Uses for Wrought Iron," which should give you some valuable tips.

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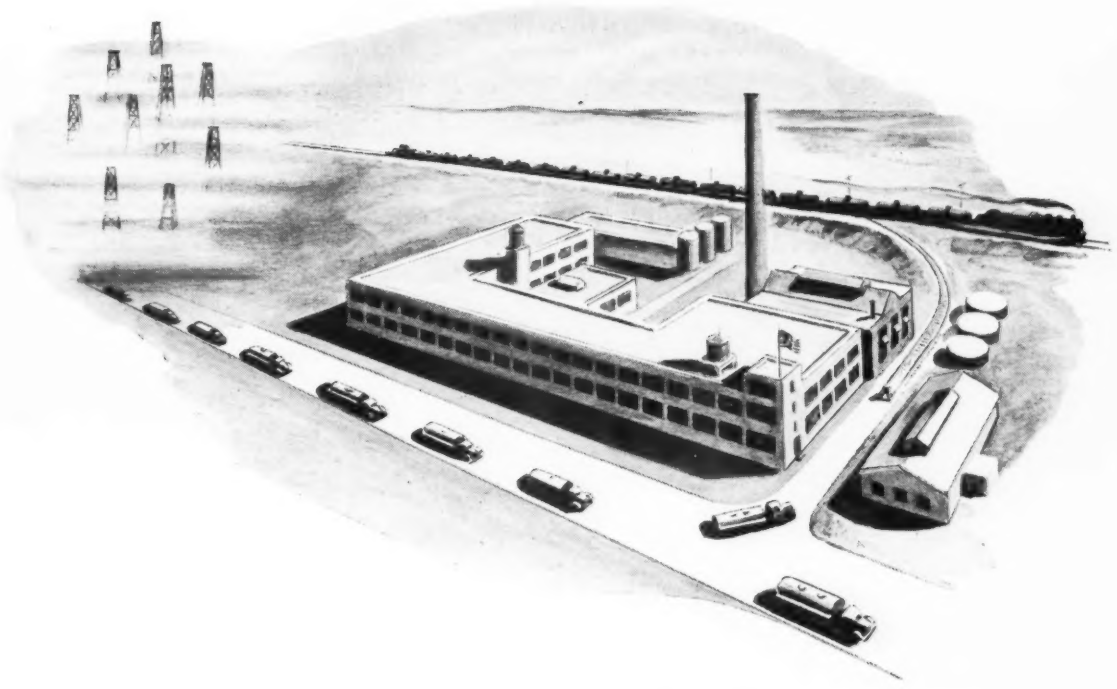
POWER

Established 1882 • PHILIP W SWAIN, Editor



Fuel-Oil Future

Safely past this winter's fuel-oil crisis, we are apt to forget how narrow the margin was, and if we think of next winter at all, it is with optimism. Such optimism is unfounded and dangerous because the outlook for next winter holds no hope of being better and may be worse. Here are the facts:

Petroleum production and demand both broke records in 1942, but demand so far outran supply that total oil stocks at the start of 1943 stood at the lowest point of the past 20 years. Discoveries and extensions of existing fields fell short of withdrawals in 1942 so that proven reserves suffered a net reduction. Previous imports of 50 million barrels no longer come through. With every possible means of transportation strained to the utmost, and 32 states under fuel-oil rationing, basic needs were barely met.

Crude-oil and refined-petroleum production in 1943 will increase over 1942, but growing demands of our own and United Nations' land, sea, and air forces, and of the synthetic rubber program, will eat up any gain in production and refining. Extension of the North African campaign and probable invasion of Europe will take most of the output of new pipelines, leaving industrial fuel-oil users no better off.

These are the hard facts that must be faced by every fuel-oil user. By the time this is published, the conversion possibilities of every oil-burning plant in restricted East coast and Midwest areas will have been considered by the Petroleum Administration for War. Under a new order (see page 134), the Office of War Utilities will direct conversions in plants using oil for power generation. As a result of this program, many plants will be *ordered* to convert. Drastic though it may seem, failure to convert on order will mean complete shutoff of fuel-oil supplies. In view of the facts, and PAW's announced policy, prompt execution of conversion orders is the wise course.

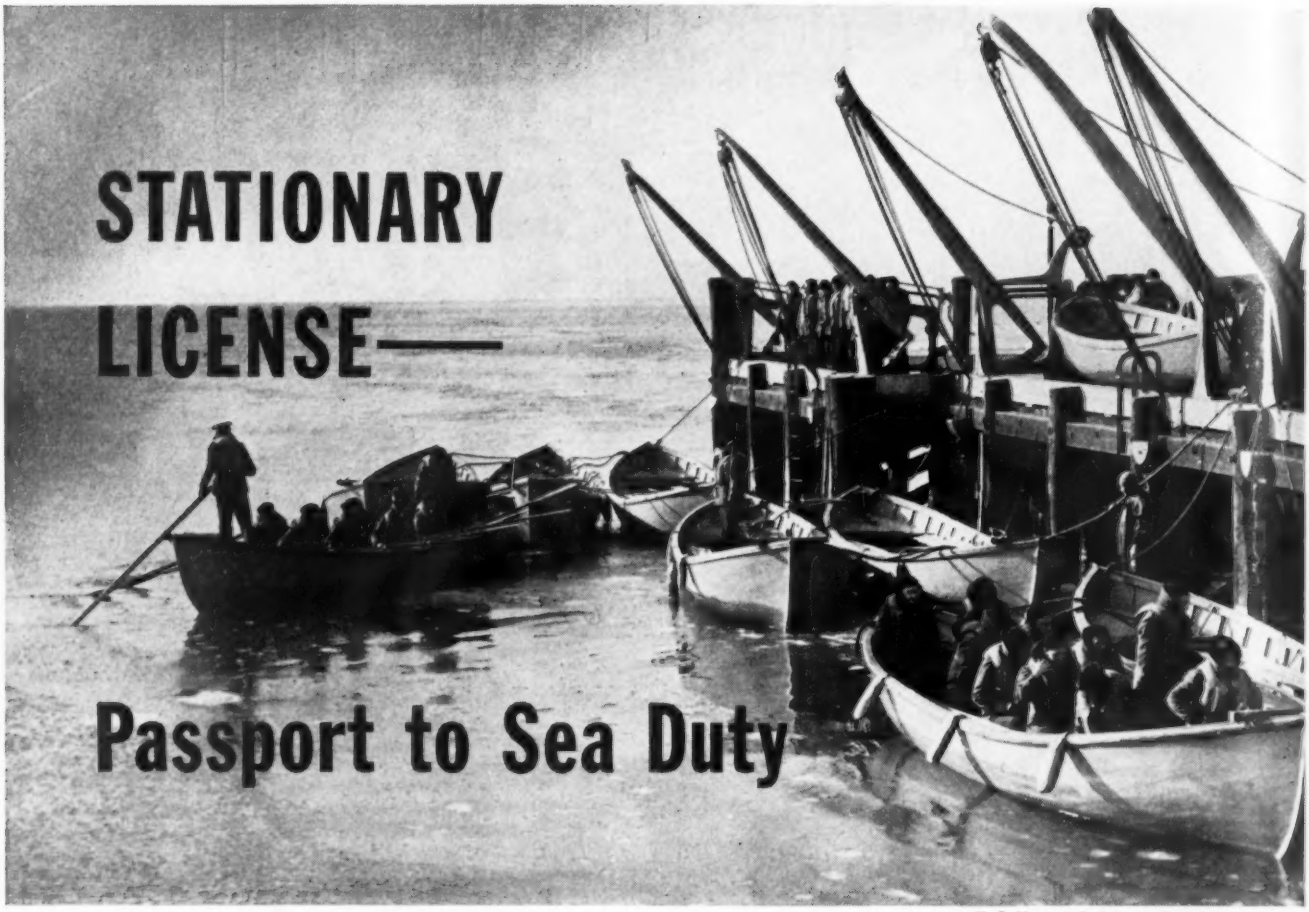
Misled by false optimism regarding next winter's prospects, some engineers will be tempted to postpone action in the hope that conditions may improve. It is impossible to stress too strongly the danger involved in such a course. The foresighted engineer will act on the assumption, concurred in by those best informed, that no relief is in sight. If so ordered, he will carry out his plant's conversion this spring or summer when it will mean least interruption to vital production, and while equipment can be obtained.

Where conversion is impossible, PAW or OWU will certify the plant to OPA for rationed fuel-oil supplies. However, receipt of a ration allowance carries no guarantee that oil supply will be maintained. Engineers of plants that cannot convert must plan to operate on reduced supplies and must be prepared for local supply failures. The PAW's recently announced colloidal-fuel program offers some prospect of partial relief for plants that must stay with oil, but it is too early yet to gage the effect of these plans.

It all boils down to this: play safe by assuming that you won't be any better off next winter than you were this, and maybe worse. Make plans accordingly—now!

STATIONARY LICENSE—

Passport to Sea Duty



U. S. Navy staff photo for U. S. Maritime Service

Training Division of U. S. Maritime Service now provides brief schooling for stationary engineers and mechanical engineering graduates to equip them for officer berths aboard merchant ships and transports

U. S. Navy staff photo for U. S. Maritime Service

Fig. 1—Every trainee gets lifeboat drill and instruction in other safety devices such as the Morner life saving suit which keeps seaman's head above water without effort

▶ FOR THE FIRST TIME in history, shore experienced men with adequate background, able-bodied and physically qualified, who can take the rap of starting at the bottom of the ladder for a brief training period, can become ship's officers in up to a year's time. First call, of course, is for men with marine licenses, particularly First Assistant Engineers who can ship at once.

Day by day and month by month, Seconds and Thirds of last year are filling higher berths, but there are too few of them. Forward looking recruiting personnel, faced with thousand-a-year ship launchings for 1943, are preparing now for an even more critical engineer shortage in coming months by enlisting licensed stationary engineers and mechanical engineering graduates.

Machinery is already set up and in operation for (1) enrolling these men for about a month or more of intensive training, (2) shipping them for a voyage up to a year's duration as unlicensed engineers and (3) examining them for Third Assistant Engineer licenses.

Among the requirements are that men (1) be physically able to care for themselves in emergency at sea, (2) have sufficient experience to require little or no training in the operation of oil-fired watertube boilers, reciprocating engines or turbines, condensers, pumps and other essential auxiliaries, (3) be willing to submit to the discipline of a training station or school ship and (4) go to sea as unlicensed junior engineers. To familiarize themselves with peculiarities of marine practice and prove their "sea legs."

Officer Candidates

Officer candidates are enrolled as Chief Petty Officer (acting) at $126 per month salary, plus clothes and lodging, with transportation furnished to the training station. Required are a proper experience record, birth certificate, naturalization papers or properly documented proof of birthplace, and passing a general medical examination.

Since stationary engineer license practice varies widely in the different states, an officer candidate must convince the Bureau of Marine Inspection that his shore experience is adequate for marine officer service. He may be required to spend as much as a year at sea before being granted permission to sit for Third Assistant Engineer license. If he is well equipped, the time may be considerably shortened at the discretion of the inspector.

To get first-hand information on what background is required and what happens to men who apply, one of POWER's staff followed through from initial contact at the New York enrolling office to initial indoctrination at stations in the New York area. Graduate engineers take a "Marine Methods" course at Hoffman Island training station or go aboard a training ship within a few days of arrival. A number of officer candidates have already partly completed their training in this manner. Stationary engineers, however, will report to Sheepshead Bay training station in Brooklyn, N. Y., for a five- to six-week period.

Enrollees from all parts of the country are checked in and assigned to dormitories under section leaders. First couple of days are filled to the brim with obtaining assignments, clothing issues and allowances, physical and dental examinations, anti-tetanus and typhoid shots, vaccination and sundry details. Whether the officer candidate holds a "master of science" degree from a leading university or has worked his way to "unlimited chief" the hard way, he is a "trainee" and must fit in with customary discipline while on the reservation and aboard ship. Prima donnas have no place in a wartime training school or merchant ship.

Discipline, essential in handling numbers of men, does not extend to selection of course of study. Having, so to speak, won his spurs in shore practice, an officer candidate reviews his background with commissioned officer instructors who hold marine licenses and have sea experience. Parts of the training program that parallel his experience are rapidly crossed off, to concentrate effort on essentials that are lacking. Responsibility for selection of work program and outside study rests on the trainee's shoulders. He can make or break his opportunity.

Some of the material taught is totally unfamiliar to shore men. For example, the rules and regulations of the Bureau of Marine Inspection differ from shore practice and are the rigid law of the merchant fleet. Every engineer must have specific knowledge of the regulations before he can undertake responsibilities at sea or, in fact, before he can pass an examination for a marine license. Essentials of these rules are boiled down for presentation during a few class sessions.

Each engineer officer has specific duties aboard ship. Thirds, for example, stand a regular watch and care for most of the auxiliary equipment. Part of the "must" program concerns outlining the job assignments normally shared by engineer officers, duties of each member of the engine department and the responsibilities of each man on watch.

Lifeboat Drill

Another essential of every man's life aboard ship is lifeboat drill. For his own sake, the engineer officer candidate mans lifeboats side by side with apprentice seaman. In emergency, at sea class distinctions are erased in a matter of seconds and the common object is to man the oars until the boat is clear of the stricken ship. Other drills cover use of firefighting apparatus, gas masks and safety appliances. Some training in first aid is required for marine engineer's license.

Traditions have persisted in clothes, habits and manners of seamen. If a man aspires to an officer berth on shipboard, he will want to observe the simple customs and courtesies common to his mates. Instructors aim at making the newcomer's path as pleasant and friendly as possible in the brief time allowed for education in these matters.

Men get actual practice with ship propulsion machinery. Even though stationary engineers are presumed to be familiar with most ship apparatus, opportunity is afforded for those who have worked with turbines to review knowledge of reciprocating engines and vice versa. Trainees concentrate attention on practical operation; little time is available for theory.

U. S. Navy staff photo for U. S. Maritime Service

Fig. 2—Drill in operation of steam cargo winch. Note full size cargo hatch at extreme right. In the background, an instructor is explaining the use of a serving board

The program tentatively laid out for stationary engineer trainees is principally devoted to marine engines, boilers and auxiliary machinery. It also includes lifeboat drill and swimming practice, brief reviews of electricity, mathematics, rules and regulations, ship organization and engine-room duties. Motion pictures and slide films aid in the instruction.

Not only are the men instructed in several types of marine boiler, but such operating practices as water treatment, care and repair, duties underway and in port, and combustion efficiency are discussed. Handling of fuel oil, oil heaters, oil burners and boiler-room safety get special attention.

At Hoffman Island, a marine boiler remains constantly open for inspection while the Station's steam supply comes from two other oil-fired units. At Sheepshead Bay ten watertube and two scotch boilers are in every day operation, as well as a large marine-type reciprocating engine.

Varied Studies

Fire-room procedure and safety precautions, practical use of tools, trap maintenance and internal ship communications are taught those who require instruction in one or more of these subjects. Other classes discuss auxiliaries such as rotary pumps, steering engine, deck machinery, evaporators, generators and refrigerating equipment. Lubrication, sanitary and domestic water systems come in for their share of attention.

Because Liberty ships are engine driven, construction and types of vertical reciprocating machinery, types of valves and valve gears, jacking and reversing equipment, and auxiliaries that run off the main engine are reviewed in class, or aboard ship.

Turbine theory, construction and operation, thrust bearings, sleeve bearings and reduction gears are taught to reciprocating and diesel men. Construction of marine condensers, tubes and packing, and operation of condensers are explained for men of fresh-water and non-condensing experience. Operation of piston-type air pumps and ejectors are explained.

Functioning and operation of diesel- and turbine-driven auxiliary sets must be mastered as well as the rudiments of diesel main-propulsion units. Bearings, babbitting and oiling systems should be familiar to all stationary engineers but instruction is available.

A well-equipped machine shop instructs those who lack experience in this important phase of the marine engineer's life—lathe, drill press and grinder.

Fig. 3—Deck gear of a C-2 vessel with motor-driven winches. Later ships use steam winches; crews must be familiar with both types *Courtesy Allis-Chalmers Mfg. Co.*

On completion of his instruction, the officer candidate is furnished with necessary passports and papers. For this, he must bring with him a birth certificate or properly documented evidence of birthplace or naturalization. With these credentials he reports to the Recruitment and Manning Organization of the War Shipping Administration for assignment to a ship. During a period of a few days to several weeks, the candidate must support himself since he is already classed as an officer even though he holds no license.

Once aboard ship as Junior Third Assistant Engineer (unlicensed) he receives basic wages of $155—185 per month plus overtime plus dangerous voyage bonuses of 40–100% of basic wage. In addition, he receives port bonuses varying from $40 to $125. Basic wage of Thirds run from $165 to $224; Seconds get $180–253 while Firsts can command $200 to $316. Chief Engineers get no overtime but are paid from $285 to $460 plus bonuses.

Conversion of stationary engineer experience into marine officer berths, recently approved, offers an opportunity to serve in an essential war capacity, open to few other classes of men. Men can allot any portion of their wages to families or other dependents. War-risk insurance of $5000 is furnished and more can be purchased.

To apply, consult the nearest U. S. Employment Service office for the name and address of the nearest U. S. Marine Service enrolling office. Visit or write that office with birth certificate, stationary license or diploma from a recognized engineering college and, if possible, a doctor's statement that you are functionally in good health. If you fail to make proper contact in this way, send your specific questions to the editors of POWER.

Packing Problems on High-Pressure High-Temperature Pumps

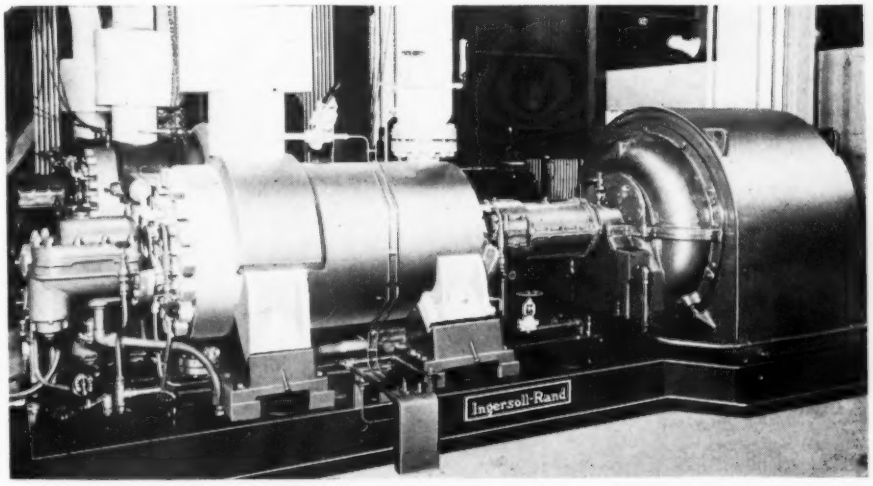
H Hornschuch, engineer, Ingersoll-Rand Co, examines some of the problems characteristic of packing used on high-pressure and high-temperature applications that led the pump builders to consider the advantages of mechanical sealing devices

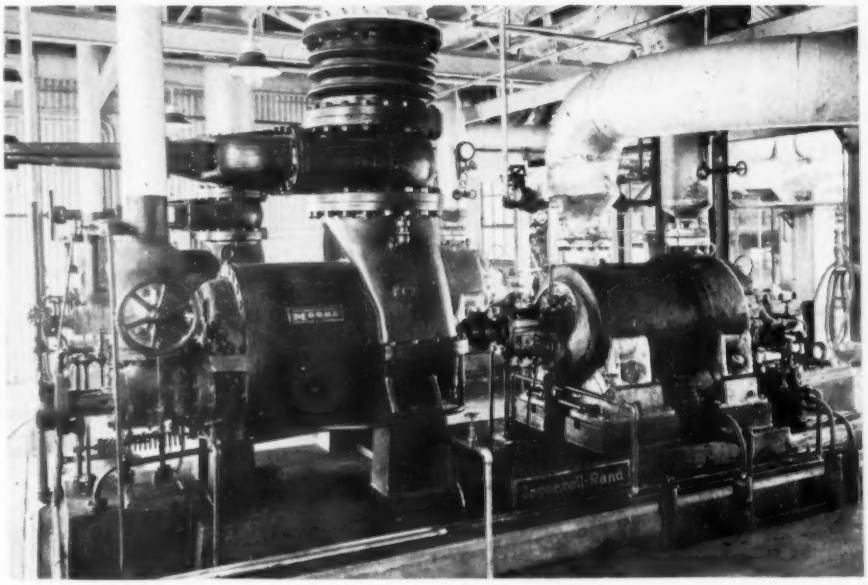
▶ IN RECENT YEARS, stuffing boxes on centrifugal pumps have become an increasingly difficult problem. An installation's reliability often depends on the successful operation of the stuffing boxes, particularly in pumps for refinery service and for boiler feed. Suction pressures against which stuffing-box packing has to seal have increased, operating speeds and temperatures have gone up, and liquids have become more volatile. This is especially true in refinery applications where many pumps handle light hydrocarbons having a specific gravity as low as 0.50, at several hundred pounds suction pressure. Centrifugal pumps for pipeline service are another example; the general trend has been to operate two or more of them in series. In such arrangements, the stuffing box on the second pump operates under discharge pressure of the first pump, and so on.

Packed Stuffing Boxes

Packed stuffing boxes of usual design, employing asbestos or so-called metallic packing, have a certain maximum operating condition governed by liquid, speed, pressure and temperature beyond which satisfactory operation cannot be expected. No universal limit can be established for this maximum condition, but each pump manufacturer has probably set a certain limit based on his own experience or experiments. In every case, when he is called on to supply a unit for conditions higher than his established limits, he has to find means to reduce existing pressure and temperature so each falls within these limits.

To reduce existing pressure, a throttle is introduced between suction chamber and packing, and the downstream side of the throttle is connected to a source of lower pressure. To reduce existing temperature, liquid coming in contact with packing has to be cooled, or a colder liquid has to be injected either at the bottom or in the middle of the stuffing-box packing. When both temperature and pressure are above the limits, both of these corrections have to be applied. Actually, pumps have been built with stuffing boxes whose throttles have several bleedoffs, and with provisions for cooling the liquid, before it reached the packing, and for injecting colder liquid. Some of the arrangements are shown in Figs. 1 and 2.





Because of high pressure and temperatures at which they operate, boiler-feed pumps (top) and oil-refinery charging pumps (bottom) present difficult packing problems

Fig. 1 shows a cross-section through a packed stuffing box arranged for leakoff and water cooling. A throttle bushing *A* of the labyrinth type, between suction passage and stuffing box, serves to keep pressure on the packing down to a predetermined value. Leakage from the pump enters the chamber around the labyrinth seal, then continues through the seal and is drained away through a leakoff to a lower-pres-

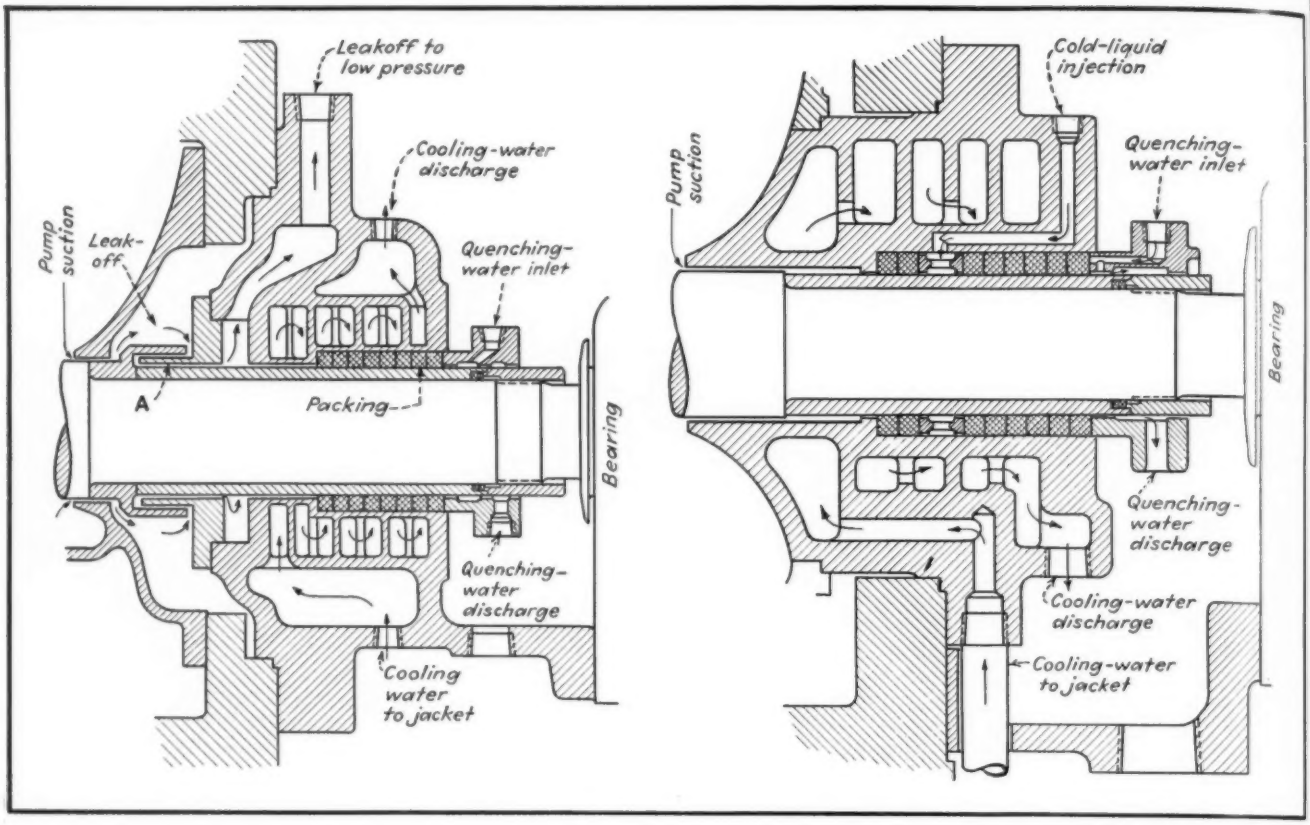


Fig. 1—Cross-section through packed stuffing box arranged for leakoff to reduce the pressure and for water cooling to reduce the temperature at which the packing must operate

Fig. 2—Cross-section through packed stuffing box arranged for cold liquid injection into the packing and for water cooling to reduce the temperature around the packing

sure part of the system. With this device, pressure at the packing can be adjusted to safe operating limits.

The stuffing box is cooled by water that flows through a series of annular passages around the box, as indicated by arrows. Water also flows through annular passages in the packing gland to quench any vapors or hot liquids that may come through the packing.

In Fig. 2, the stuffing box is water cooled and quenching water is admitted to the packing gland, as in Fig. 1. In addition, a connection is made to a lantern ring, near the inner end of the packing, for cold-liquid injection to cool and lubricate packing and shaft sleeve and reduce their wear.

Packing Problems

Fundamentally, every packing problem is a straight friction phenomenon similar to the one of a friction brake. The packing is forced against the shaft or shaft sleeve in order to prevent leakage and the resultant contact pressure generates a certain amount of friction. Magnitude of this friction depends largely on the type of lubrication and, in turn, on the viscosity of the lubricating liquid. Fluid passing between packing and shaft not only reduces the friction, but also carries away the heat generated by friction. Water jacketing outside of the packing is not adequate to carry away all the heat because of the packing's rather low heat-transfer qualities.

To operate packing successfully, it is imperative to have a small amount of leakage passing between packing and rotating member at all times. Even the best packing, running on the finest shaft-sleeve material available, will not last long when lubrication is shut off. Of course, in some cases packing friction can be lowered considerably by lubricating the packing with oil or grease. This can usually be allowed only on refinery applications handling hot oil or light hydrocarbons, and not on boiler-feedwater pumps or other pumps handling liquids where oil or grease getting into them would be objectionable.

In contrast to the time when cotton packing and bronze shaft sleeves could handle any job, packings and shaft sleeves today represent a considerable investment; therefore they must give reasonably long service. Basically, packing material today differs very little from that used a decade ago. It is still made of asbestos but various metals are added, or it is clad with soft-metal coverings. Materials for shaft sleeves, however, have undergone a drastic change. Very hard materials, with Brinell hardness up to 800, are available; also in common use are stainless materials, as well as sleeves having hard surfaces applied by welding.

Let us now examine some facts characteristic of packing when fairly high pressure or temperatures are involved —facts that made the pump builders conscious of the advantages of mechanical-sealing devices.

Packing Applications

The human element plays a great part in the operation of a packed stuffing box. Life of its parts is generally in the operator's hands. If he pulls the packing up too tight, lubrication may be shut off, packing may begin to smoke, and it and shaft sleeve may be seriously damaged. To replace the shaft sleeve, the pump has to be at least partially dismantled, and thus is temporarily out of use.

Initial starting-up of pumps, especially those on large boiler-feed systems, represents a complicated operation. Packing must be broken in very much as a serious pipe smoker breaks in a new pipe. First, special spacing rings—the bottom ones of the packing—have to be pressed into the bottom of the box.

(*Continued on page* 144)

20:1 Speed Units Drive Coal-Pulverizer Feeders

Driven by adjustable-speed dc motors supplied from ac power through variable-voltage control units, coal-pulverizer feeders supply two of the largest automatically controlled boilers in central service that heat downtown St. Louis

▶ COAL PULVERIZERS, equipped with feeders driven by variable-voltage adjustable-speed power units, supply two of the largest boilers in central steam-heating service, operating at 250 psi pressure. Installed in the Ashley St Station of the Union Electric Company of Missouri, these boilers supply heating steam to downtown St. Louis, Mo. where the peak load in the morning reaches 300,000 lb per hr per boiler and in the night drops to 40,000 lb per hr per boiler.

The four coal feeders on each boiler are arranged in pairs, each pair driven by a 3-hp variable-voltage adjustable-speed power unit, of the Reliance Electric & Engineering Co.. Each of these units consists of a totally enclosed, fan-cooled dc motor connected to a pair of feeders, Fig. 1, and a vertical-control unit that supplies power to the feeder motor.

Each of the four vertical-control units, Fig. 2, has an exciter and a direct-current generator driven by a 440-v 3-phase squirrel-cage motor. The exciter provides constant voltage to excite the generator and the feeder-motor field coils. The generator armature connects directly to the motor armature, and speed of this motor is adjusted by a rheostat in the generator field-coil circuit. The control units are located in a switchgear room where they are free from grit and coal dust. Only the feeder-drive motors are exposed to coal dust from the firing equipment and these are totally enclosed and fan cooled to protect their windings.

A Bailey automatic combustion control regulates performance of each boiler. It automatically adjusts two generator field rheostats to control the speed of the motors and therefore the amount of coal feed to the Riley pulverizers. A slight change in steam pressure causes a corresponding change in feeder speed to meet the new steam demands. Close regulation can be obtained, as each feeder motor provides a speed range of 20:1, sufficient to meet practically every load requirement of coal feed. On test, a maximum speed range of 22:1 was attained by the motors driving the feeders. On each drive, the differential rheostats permit a speed change of plus or minus 5% to allow the operator to balance manually the coal that is fed to each pulverizer.

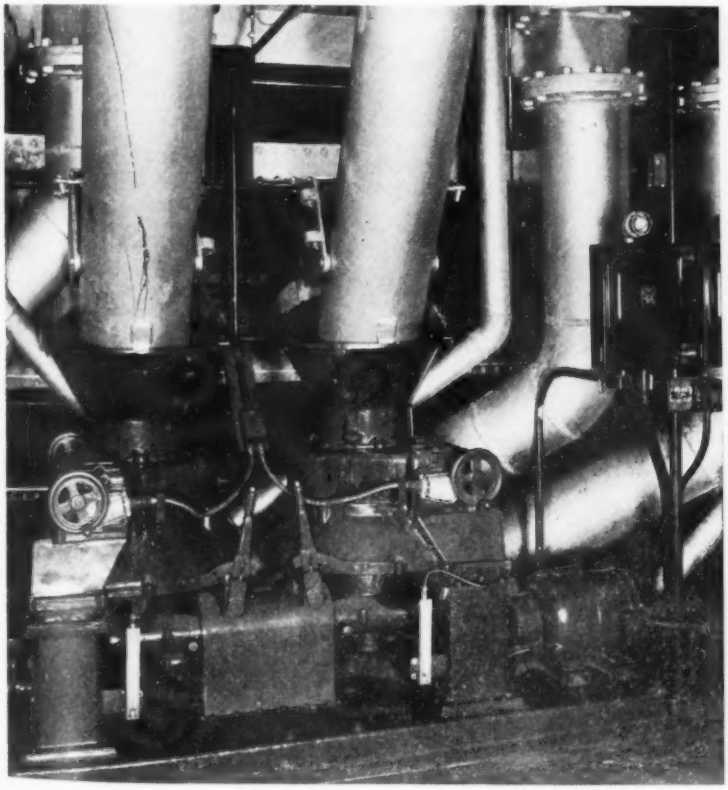


Fig. 1—Each boiler has two pairs of coal feeders, each pair driven by a totally enclosed, fan-cooled motor that is part of variable-voltage adjustable-speed control unit

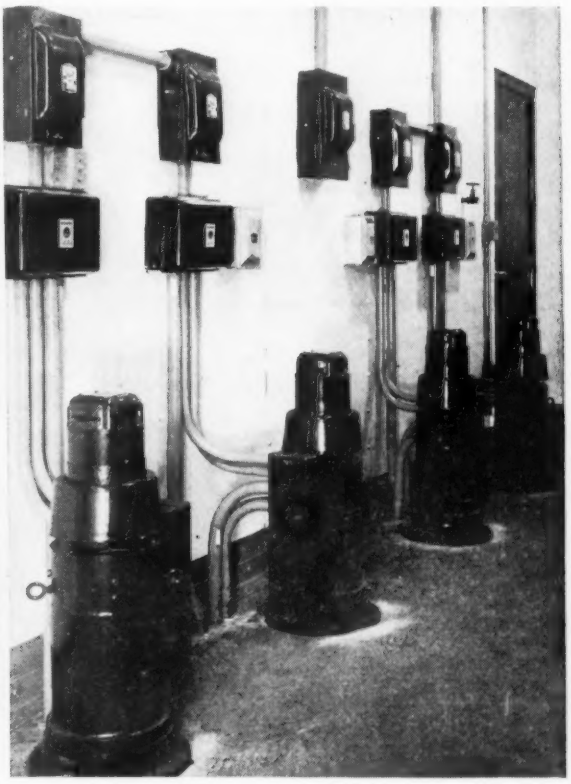
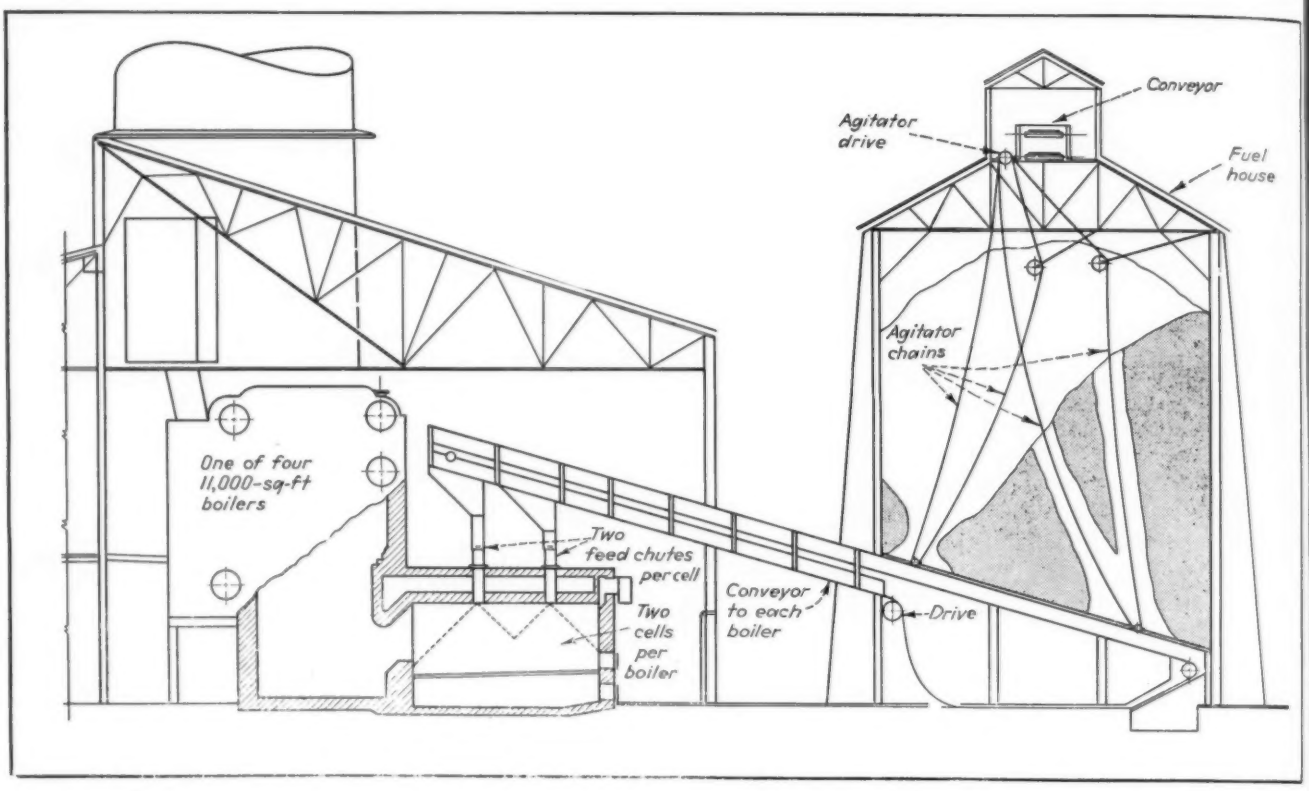


Fig. 2—These four 3-hp vertical variable-voltage control units are located in a switchgear room near the coal feeders where they are free from coal dust and grit

If You Want Increased Capacity and Efficiency



Four 11,000-sq-ft units make up the boiler plant. A single conveyor carries hog fuel from the storage house to each boiler, discharging through four feed chutes to flat grates in the 2-cell Dutch oven. Note agitator chains in storage house

▶ WHEN, AS IS USUALLY THE CASE, the supply of wood waste far exceeds fuel needs, engineers make little effort to study the nature of the fuel or to develop efficient methods of burning it. However, as load demands on existing plants increase, need for higher boiler output focuses attention on fuel and firing as possible sources of improvement. This article presents results of studies made in a plant where higher output was desired, and should provide some interesting ideas for other engineers facing this problem.

Hog-Fuel Composition

In woodworking plants the term *hog fuel* applies to waste that is prepared for boiler fuel. It generally consists of sawdust and shavings, which require no preparation, mixed with a coarser form of wood, called *hogwood*. The latter is prepared from slabs, edgings and other large waste pieces by chipping or chewing in a *hog*.

Shavings usually being negligible, the relative proportion of hogwood and sawdust makes considerable difference in behavior of hog fuel on a grate. A mixture high in sawdust burns less readily than one high in hogwood. The reason usually advanced, and rightly, is that sawdust blankets the fire so that undergrate air cannot penetrate through the mass. Tests made in our plant, in connection with another problem, show clearly how much difference the proportion of sawdust makes.

In the tests, we measured resistance of uniform layers of hogwood (screened over ½-in. mesh) and sawdust (screened through ½-in. mesh) to air flow. From the results, we worked out formulas which indicate the relative resistance to air flow. For hogwood, the pressure drop, up to a depth limit of 5.5 ft, is expressed as follows:

$$\Delta p = \frac{V^2 h}{78{,}200}$$

And for sawdust, up to a depth limit of one foot:

$$\Delta p = \frac{V^2 h}{2710}$$

In the above, p = pressure drop, in. H_2O; V = air velocity, fpm (superficial); and h = depth of fuel, ft.

These formulas indicate that for equal depths and air velocities, pressure drop through sawdust runs roughly 29 times that through hogwood. Little work was done on mixtures of the two fuels, but indications were that pressure drop varies directly with relative proportions of the two. Further tests should be made to verify the present data and extend it to various mixtures.

Hogwood-Sawdust Ratio

The hogwood-sawdust ratio affects most heavily those plants in which only part of the available waste is needed as fuel and the remainder is burned in a refuse-burner. In many cases, conveyor arrangement is such that all sawdust goes into the fuel circuit with only enough hogwood added to fill out requirements. When power-plant operation is continuous, proportions vary throughout the week. At the beginning, level in the fuel house is low and it must be refilled. More hogwood is made to meet this extra demand, and sawdust percentage is lowest. Toward the end of the week the fuel house runs full. Hogwood production is at a minimum, and this means sawdust percentage runs high.

Dimout regulations affecting plants in coastal areas now add another complication. In our plant, we shut down the refuse-burner during night hours to conform to regulations. This means

Wood-Burning Furnaces—

Look over these helpful ideas from G L Graiff's West Coast plant, where tests on redwood hog fuel and grate designs pointed out ways to boost output to meet load demands

Why agitator chains are necessary—arching properties of hog fuel make handling in large storage piles extremely difficult

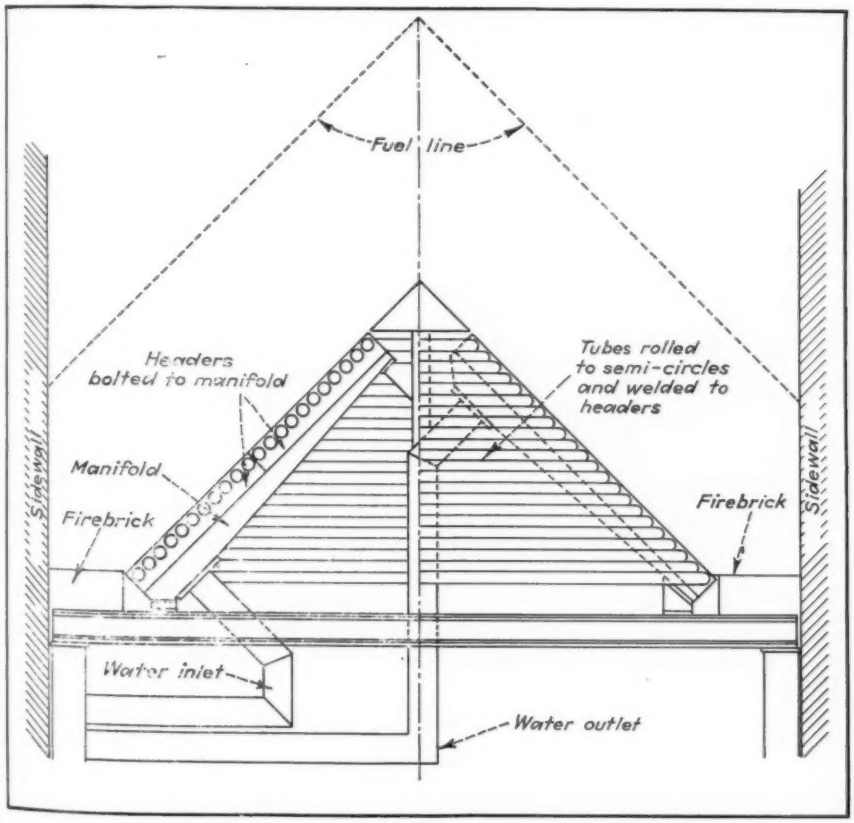
hogging everything during the night shift and burning all slabs during the day. Because all sawdust goes into the fuel circuit, the day fuel consists of almost 100% sawdust. Breaking down stored fuel to mix with sawdust improves the mixture somewhat, but sawdust still forms its major portion. On the night shift, hogwood percentage runs higher. Thus, fuel entering the Dutch ovens varies from about 90% sawdust on the day shift to 20% sawdust at night, with a mixture of about equal proportions on the graveyard shift and over week ends.

Flat Grate Fuel Beds

When burned in a conventional Dutch oven with flat grates, fuel piles up in a cone under each feed hole. In our plant, Dutch ovens are two cells wide with two feed holes per cell. Each cell measures 8 ft wide by 18 ft long. Feed holes center over equal areas of 72 sq ft making total furnace area equal to 288 sq ft.

Photographs indicate that the angle of repose of the fuel pile, in this particular case, varies between 40 and 50 deg. Taking 45 deg as an average, it is evident that the conical pile has to be at least 6 ft deep if the corners are to be covered. Our Dutch ovens are 8 ft high and we generally keep the pile to within 1 ft of the top, or 7 ft deep at the center of the cone.

Because this kind of fuel bed presents extremely high resistance to air flow at the center of the grate, the rate of combustion around the edges is much higher than in the zone directly under the feed hole. Accordingly, some installations have been made with, and others changed to have grates at the edges only. In this setup the center is left blank. This approach has for some time seemed wrong to me. On the other hand, blanking off the edges and leaving the center open seems to offer definite advantages.



Suggested conical water-cooled grate gives even fuel bed thickness and thus nearly uniform resistance to air flow, improving combustion at center of pile

Before experimenting, we tried to figure out what the effects of such a change might be. As soon as we laid out a cross-section of the fuel pile on a diagonal through the center, one thing became apparent: The relative depths across the diagonal line vary from less than 1 ft at the corners to a maximum of 7 ft at the center. With the center blanked off (which is 50% of the area), volume of fuel above the open grate area amounts to less than that above the blank space. The effective volume, moreover, is even less because the products of combustion and distillation tend to follow the path of least resistance, which is on a line perpendicular to the surface of the fuel. The projection of a perpendicular line from the edge of the blanked area intercepts the surface a good distance away from the edge of the blanked area.

Edges Blanked Off

With edges blanked off, the average depth of fuel becomes greater, and the minimum depth equals the maximum depth of the alternate scheme of blanking the center; the line perpendicular to the surface intercepts the blanked edge. Volume of fuel above the grate, moreover, is greater by far. Value of large fuel volume lies in the fact that

(*Continued on page* 140)

Safe Capacitor Selection for Power-Factor Improvement

How to select and install capacitors that give ample power-factor improvement without subjecting motors and transformers to excessive voltages and other bad effects, as set down by J E Barkle, district engineer, Westinghouse Electric & Mfg Co

► CAPACITORS ARE BEING installed in tremendous numbers to improve power factor so that feeders, transformers and generators can supply more power for our rapidly expanding industrial loads. They also improve voltage regulation, reduce power losses and cost. When power is purchased on a rate schedule that contains a low-power-factor penalty clause, reduction in power cost pays for the installation in a short time. Consideration must be given to selection, however, or capacitors may cause excessive voltage and insulation failures in the power system.

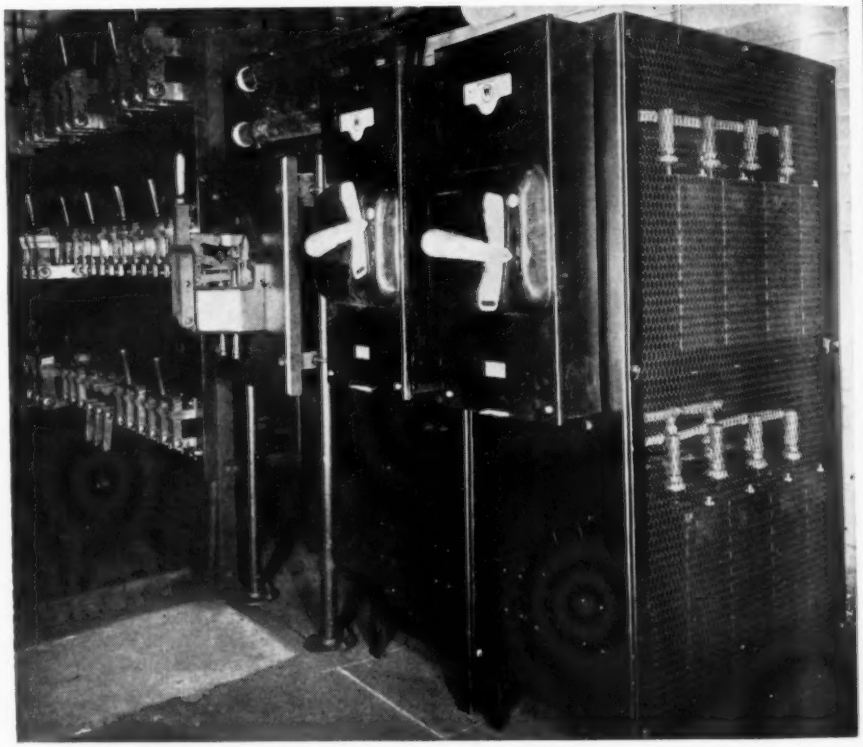
Capacitor Locations

Most shunt capacitors are installed to improve power factor of industrial loads made up of large numbers of induction motors. They are applied at any one of the following three locations on industrial power systems:

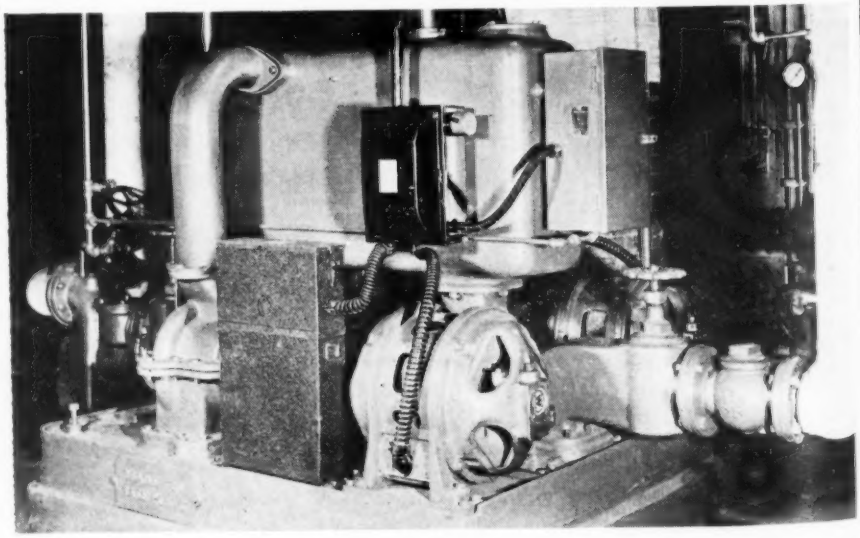
1. Group installations where one bank of capacitors, connected as at *A* or *B*, diagram, page 77, improves the power factor at the substation for an entire plant. With the capacitors located at *B*, the lines and equipment on the transformer side of the busbars only are benefited. On the load side of the substation, total current in the lines to load centers and from load centers to loads remains the same as before the installation, for equal kilowatt loads on the system.

2. A group of capacitors at each load center supplying a low-power-factor load as at *C* in the diagram. At these locations, capacitors reduce current in the feeders, connecting the load centers to the substation, as well as in the distribution and generating equipment. In the feeders to the individual loads, however, the current remains the same as before the installation.

3. One or more capacitor units connected directly to the terminals of each induction motor, as at *D* in the diagram. This method is the most expensive, but benefits the power system most because



Two 6-unit 90-kva dust-tight capacitor equipments mounted on top of feeder circuit-breaker panels to improve power factor and voltage regulation of the feeders



The installation of a 15-kva dust-tight capacitor on an induction motor that drives a condensate pump improves the power factor right at the load

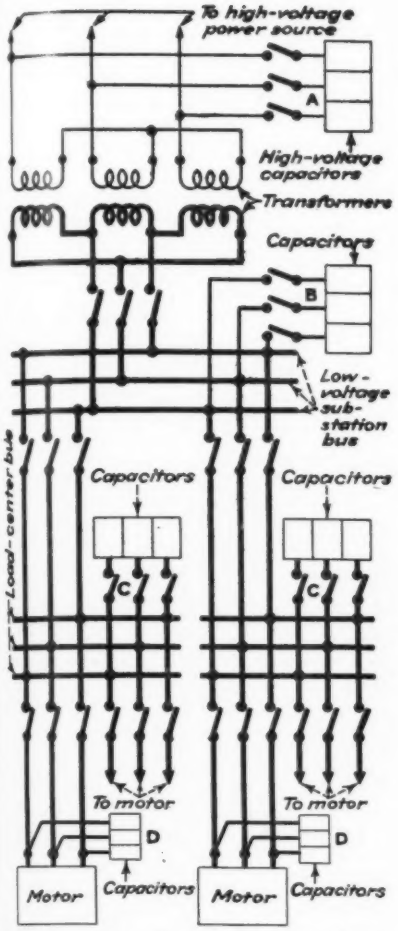


Diagram of industrial-plant transformer substation and power-distribution system showing possible locations of capacitors for power-factor improvement

■

the power factor is improved from the motor terminals to the generators.

Any one or all of these methods may be used on a single industrial power system to improve power factor. However, method No. 2, where the capacitors are placed at the load centers, is the one most generally applied. With any one of these, precautions must be taken to prevent trouble. The first two methods are comparatively easy to analyze, but the third involves a study of motor and capacitor characteristics.

Voltage a Factor

When an industrial plant takes power from its own main transformer bank, the capacitors may be connected to either the transformer primaries or its secondaries. If more capacity is needed, install the capacitors on their secondaries, as at *B*, because when connected here they reduce the load on the transformers. When power is distributed at 230 v with ample transformer capacity for the load, it may be more economical to connect the capacitors to the transformer primaries, as at *A*, because 2400- or 4160-v capacitors cost considerably less than 230-v units. The higher cost of low-voltage capacitors is, however, partially compensated for by their lower switchgear cost. When power is distributed at 460 v, installation on the secondary side of the transformers is justifiable.

Capacitors must be of such rating as to improve plant-load power factor to a satisfactory value, usually 90 to 95%. Kva rating of capacitors is based on a consideration of plant load and power factor and the rate schedule when power is purchased. The plant load may be high at one time in the day and low at other times. This adds a complication because a much larger kva of capacitors is required to improve the power factor to a desirable value during heavy loads than during the light-load periods.

If sufficient kva of capacitors is installed to improve the power factor properly during heavy loads when power-factor improvement is most desirable, the capacitors will be too large for light loads. A large installation on a light load may cause overvoltage on the system by over-excitation of transformers and motors. This voltage rise is not usually sufficient to cause insulation failures, but if lights are supplied from the system, lamp life is reduced. Also, excessive harmonic currents may be circulated between capacitors and transformers that will blow the capacitor fuses or overheat the transformers.

To prevent trouble caused by overvoltage and harmonics, divide the capacitor bank into sections with suitable switching devices. Then, to provide the desired power-factor improvement, sections can be switched off when they are not needed and connected into circuit when the load increases. Switching may be either manual or automatic.

Overvoltage Failures

Records show that most failures of equipment, caused by overvoltage, occur during nights and week ends when industrial plants are lightly loaded. Manual switching can therefore be used to remove part of the capacitors from the system during periods of light loads.

Capacitors improve voltage regulation as well as power factor. This makes it possible to use automatic switching to connect or disconnect them. For example, if normal bus voltage is 460, automatic switching can be used to disconnect part of the capacitors if the voltage goes above 470 and to connect them back on the system when the voltage drops to 450. Low voltage occurs during heavy loads when maximum capacitor kva is needed to improve both voltage and power factor. Conversely, high voltage develops during light loads when minimum capacitor kva is needed on the system. A time-delay device can be included in the control to prevent switching operations during momentary load surges.

As previously mentioned, capacitors are connected to individual feeders to improve the power factor of their loads. Frequently, the feeder breakers are opened during the night or other light-

Table 1 — Capacitor Kva Necessary to Improve No-Load Power Factor of Open-Type General-Purpose Squirrel-Cage Motors to Unity

Motor hp	*Maximum Capacitor Rkva at Given Motor Speed*					
	3600 rpm	*1800 rpm*	*1200 rpm*	*900 rpm*	*720 rpm*	*600 rpm*
3	0.7	0.9	1.2	1.3	2.5	2.5
5	1.2	1.6	1.8	2.4	4.3	4.2
7.5	1.7	2.3	2.6	3.5	5.0	5.5
10	2.4	3.0	3.4	4.8	6.0	7.0
15	3.6	3.3	4.7	5.8	7.3	8.0
20	5.0	3.7	6.0	7.0	8.7	9.8
25	6.5	4.5	7.6	7.7	10.2	13.0
30	8.0	5.5	9.3	8.6	11.5	16.0
40	9.8	7.2	10.7	12.7	14.5	20.2
50	12.0	9.1	11.9	17.0	17.4	24.4
60	13.8	11.8	14.0	18.4	21.7	28.5
75	16.5	15.8	16.9	20.5	28.2	34.7
100	21.0	20.7	22.5	24.8	34.0	40.0
125	25.5	25.6	28.0	29.1	39.4	45.6
150	31.2	29.8	30.8	35.2	44.0	50.3
200	42.3	37.9	36.3	47.1	54.0	60.0

load periods. In these cases, the capacitors can be connected so that they are disconnected with the load. This would tend to keep the ratio of capacitor kva to load kva within permissible limits and prevent overvoltage. However, if the feeder breaker normally remains closed during light-load periods, automatic or manual switching must be provided to disconnect at least part of the capacitors when the load is light, to prevent overvoltage. Automatic switching of these capacitors can be controlled by voltage regulation, feeder power factor, current or reactive kva.

On individual feeders capacitors are most effective when installed at load centers, because they improve the power factor of the load on the entire feeder. Being in groups smaller than one-group installations, they frequently can be hung from ceiling or wall, and therefore do not require any floor space. Smaller breakers can usually be used since short-circuit currents are smaller than for capacitors connected nearer the power source. Expensive concrete foundations and conduit runs are not required for feeder capacitors and the feeders can carry more load up to the point where the capacitors connect.

On the other hand, a large-group installation is desirable if final distribution of load is uncertain. Also, in plants having high ambient temperatures or a corrosive atmosphere, capacitors installed in one group out of doors are recommended.

Connecting capacitors directly to load terminals provides the simplest and most effective means of removing them from the line during light-load periods. Since induction motors usually constitute the major part of low-power-factor loads, individual capacitors are frequently connected to the motors on the load side of their starters. With this arrangement the motor and its capacitor are disconnected from the line as a unit so that at light loads capacitor kva connected to the system is never excessive. However, connecting capacitors to induction motor terminals introduces a problem of keeping capacitor kva below a safe maximum.

Induction Motors

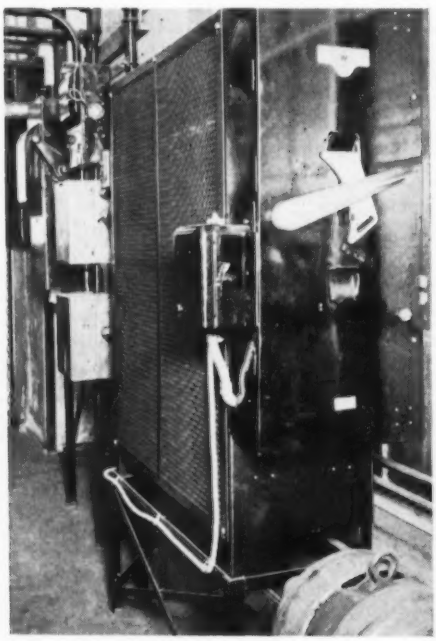
When an induction motor with a capacitor connected to its terminals is disconnected from the line, the capacitor provides excitation current for the motor, causing it to act as an induction generator under certain conditions. If the capacitor kva is large enough and the motor and load inertia are high, the motor may generate a voltage sufficient to rupture the capacitor or motor insulation. The higher the capacitor kva compared to its motor horsepower, the higher the generated voltage, assuming constant motor speed for a short time after disconnection. Besides endangering the insulation, the high voltage produces abnormal currents that cause arcing and burning of line-switch contacts when the circuit is opened. It is difficult to determine how large a capacitor may be without causing excessive voltage, unless the motor-characteristic curves are available.

However, the majority of motors will generate about 165% normal rated voltage when disconnected from the line with a capacitor connected to the motor terminals having a kva rating equal to the motor horsepower, for example, a 25-kva capacitor connected to a 25-hp motor. Some motors under favorable conditions may generate 200% normal volts with this ratio of capacitor kva to motor horsepower.

A rule tentatively followed by motor manufacturers recommends a capacitor size not greater than that necessary to improve the no-load power factor of the motor to unity. The table gives the no-load reactive kva of open-type general-purpose squirrel-cage motors, which is the capacitor kva necessary to improve their no-load power factors to unity. These values are the maximum allowable capacitor kva that may be applied to general-purpose squirrel-cage motors of a given speed and horsepower, unless a check is made for overvoltage. Any size capacitor may be used as long as its kva rating does not exceed the value in the table for a given motor; otherwise, trouble may be encountered as a result of self-excitation. Ordinarily, capacitor kva for a given application will be smaller than that indicated.

If larger capacitors than indicated in the table are desirable, they should be chosen by calculations so that the self-excitation voltage will not exceed 165% capacitor-rated volts, provided this overvoltage does not exist for more than 12 min. This may not be a safe voltage

(*Continued on page* 146)



Left—One of several 180-kva, 575-volt capacitor banks installed at load centers where main feeders end in a large textile mill

Right—Typical of group power-factor improvement, this bank at a plant load center cost $3520 and saves $2640 annually

Some Practical Considerations on Standby Boiler-Feed Pumps

Most plants have spare feedwater pumping capacity, but not all protect its operating availability. Here is a review of some pump facts, by Igor J Karassik, Worthington Pump & Machinery Corp, that every operator should have at his fingertips*

▶MERE MENTION of interruption of feedwater supply to high-pressure boilers makes power men shiver. No feedwater—no steam—no power, maybe no boiler. Designers build standby into the boiler-feed pumping system as a matter of course, both to protect against loss of a pump and against loss of drive. This review discusses merits and disadvantages without attempting to recommend any single system as best for all conditions.

Standby feed pumps not only serve an emergency function, they also take over during periodic inspection and overhaul of the other pumps. Because overhaul schedules vary widely and because reliability of drive equipment and source of power is difficult to evaluate, the amount of spare pump capacity and its arrangement are not easily determined by a set of fixed rules. Especially today, when pumps require critical materials that could be well utilized elsewhere, the task of the designer is made exceedingly difficult as, on the one hand, pressure is applied on him to install minimum spare capacity while on the other he dares not steer too close to an inadequate margin of safety in a plant that will be run at its limit of capacity.

Overhaul Outage

Ease of overhaul of the pumps of a given installation affects the selection of standby equipment to a marked extent. In low-pressure stations where a sufficient complement of spare parts is kept on hand, the overhauling operation is not serious and can usually be accomplished in a 24-hour period. For this, a single spare pump can be readily accepted since the station will never have to run without a spare pump for more than a single day.

In high-pressure stations, however, construction of feed pumps is more complex. Even with spare parts and proper equipment it may be a matter of weeks before a pump can be completely overhauled and returned to service. Obviously, a greater amount of effective spare pumping capacity must be provided for the high-pressure stations.

A number of rules should be observed for intelligent use of standby feed pumps. One of these calls for a flow metering device in each pump connection to allow frequent check of actual pump performance against manufacturer's test curves to disclose potential mechanical difficulties before they be-

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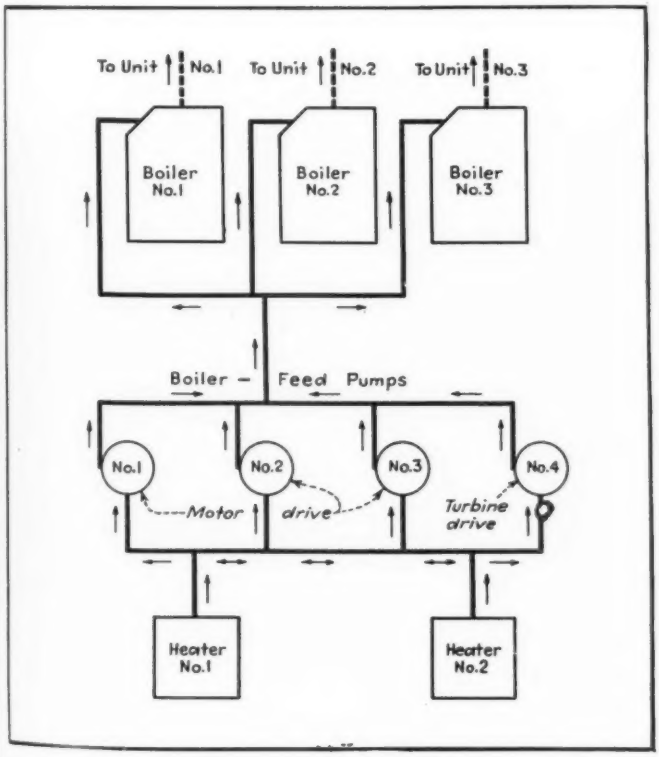


Fig. 1—Typical arrangement of motor-driven and turbine-driven feed pumps supplying several boilers. Valves and controls not shown

Fig. 2—Components of turbine-driven auxiliary centrifugal oil pump for starting and emergency service

come serious enough to cause shutdown of pump. When the first appreciable signs of decreasing effectiveness appear, the spare feed pump can be brought into service while the operating personnel inspect and repair the worn unit.

Each flow metering device should be equipped with an alarm signal to warn of flow below an established minimum. As an alternate, a pressure switch may be located in the boiler-feed discharge header to indicate loss of pressure. A pressure switch or low-flow alarm in the pump discharge operates instantly on loss of water, gaining precious seconds for operators to start up standby pumps before the conventional low-water alarm on the boiler drum detects lack of water.

Shifting Drivers

More wear and maintenance is generally expected of the pump than of drive motor or turbine. For this reason, the practice of installing more pumps than drivers has not been popular, since it also requires shifting either a pump or driver from its base in event of pump trouble. Instead, a sufficient complement of spare parts can be kept on hand to enable operators to rebuild the pump if necessary.

When a battery of pumps feeds a single boiler or several boilers in parallel, Fig. 1, they are usually manifolded in such a way that any one or any combination of pumps can feed any one or any combination of boilers, each equipped with individual feedwater regulators. Feed lines, may, of course, be duplicated. When a pump is on standby duty, it is held ready for starting with suction and discharge valves open, the discharge check valve preventing reverse flow through the pump. To maintain the idle pump at or near operating temperature, a constant small flow is generally provided from the open suction through a warm-up valve on the pump side of the discharge check valve.

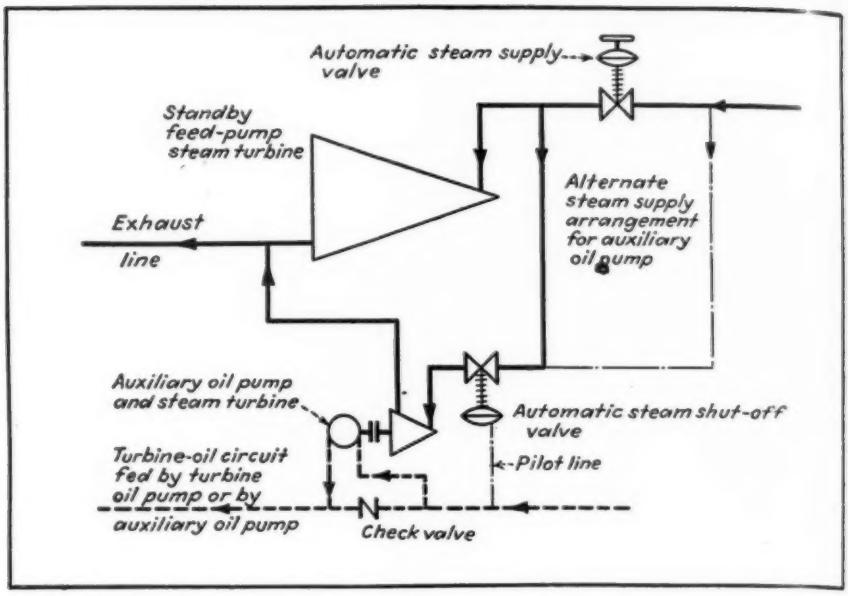

Automatic steam supply valve
Standby feed-pump steam turbine
Exhaust line
Alternate steam supply arrangement for auxiliary oil pump
Auxiliary oil pump and steam turbine
Automatic steam shut-off valve
Turbine-oil circuit fed by turbine oil pump or by auxiliary oil pump
Pilot line
Check valve

Fig. 4—Schematic arrangement of automatic-start standby pump with separately driven auxiliary oil pump to supply lubrication during starting

While it is recommended that boiler-feed pumps be heated for 15-30 min before starting it is often necessary to cut in a cold spare pump quickly in emergency. Theoretically, therefore, the emergency does not entail the manipulation of any valves if the pump is motor driven, and of only the steam throttle valve for turbine drive.

Actually, however, such items as starting up the cooling-water supply, checking lubrication and opening turbine drains must be worked out in advance by the operating personnel so that they will be carried out according to routine in emergency. The requirements can best be visualized by reviewing normal practice.

Starting Procedure

A typical outline of starting procedure for motor-driven pumps would be: (1) supply cooling water to bearings, (2) supply cooling water to stuffing boxes, (3) open recirculating valve, to avoid overheating, (4) close warm-up valve, (5) close motor switch, (6) check stuffing-box leakage to assure packing lubrication, (7) check oil supply to bearings and oil temperature, (8) close valve in recirculating line when proper flow has been established.

To shut down a pump, (1) open valve in recirculating line, (2) trip motor switch, (3) close valve in recirculating line when pump comes to a standstill, (4) close water supply to bearings, (5) close water supply to stuffing boxes, (6) open warm-up valve for standby duty. The actual order of procedure may, of course, be somewhat modified at the discretion of the operating personnel to suit local conditions. For example, the valve in the recirculating line may be kept open at all times unless the pump is in service and delivering sufficient flow. This arrangement eliminates one step from the starting routine in emergency.

For turbine-driven pumps, also (1) supply cooling water to turbine oil cooler, (2) open drains from steam inlet, exhaust and casing, (3) open exhaust valve if normally closed, (4) open throttle valve to start turbine roll-

(*Continued on page* 162)

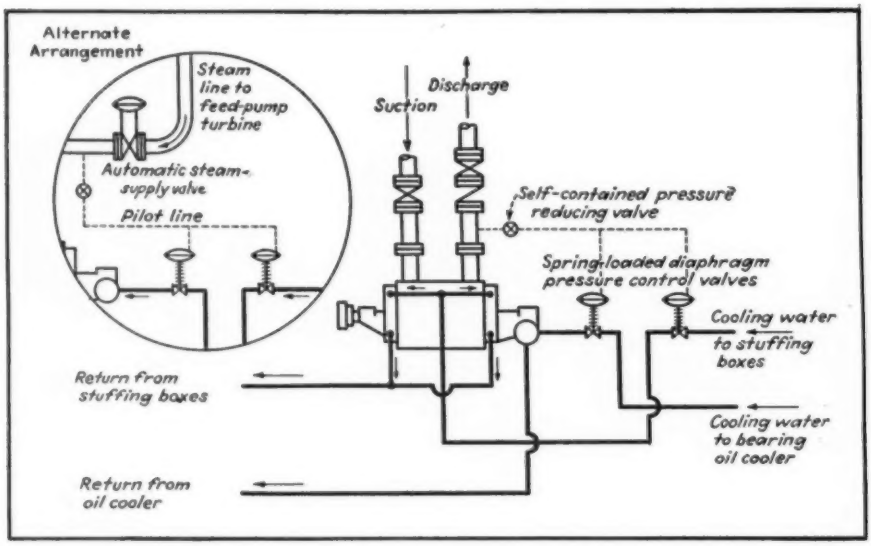
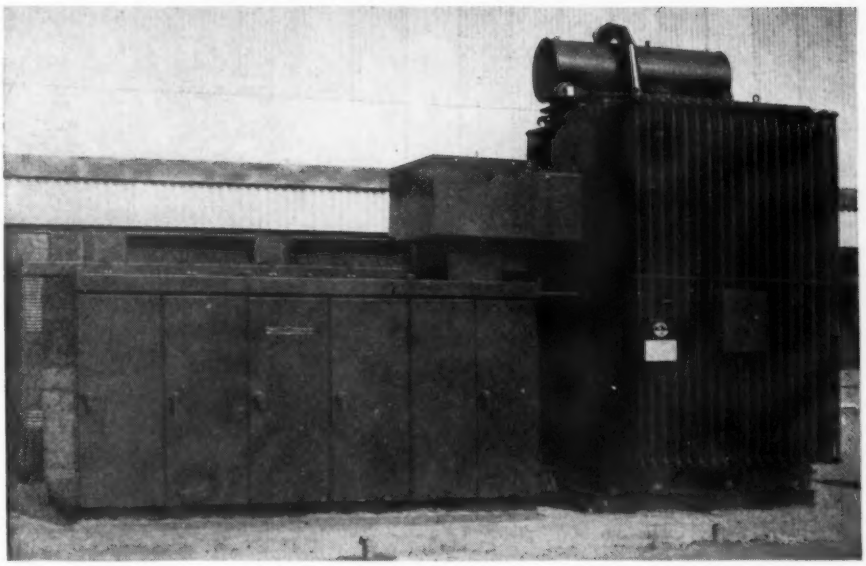


Fig. 3—Automatic control for cooling water supply in which pressure impulse from pump discharge or steam supply opens diaphragm valves as pump starts



Industrial plant unit substation consisting of a 3-phase 4500- to 6000-kva 13,800- to 2400-volt transformer, switchgear and other auxiliary equipment for four outgoing circuits

Transformers for Wartime Substations: Single-Phase vs 3-Phase

By E M HUNTER
Central Station Engineer
General Electric Co

Compares advantages and disadvantages of three single-phase transformers with those of a 3-phase transformer in a unit substation supplying power to industrial-plant loads

▶IN MANY WAR PROJECTS using load-center systems, power demands in the plant require transformers at the master substation from which the load centers are fed. Some operators favor single-phase rather than 3-phase power transformers for these plants. Then, in the event of a transformer failure, either a spare single-phase unit can replace the damaged one, or the bank can operate in open-delta. However, this is not the only consideration.

While a master unit substation can be designed to utilize single-phase transformers, the 3-phase design makes a better arrangement. Three single-phase transformers require far more extensive connections to the switchgear than does a 3-phase transformer. These connections require considerably more field assembly work and this increases the chances of failure afterward. Furthermore, many applications of unit substations require bus-voltage regulation by load-ratio control. This equipment can be more readily adapted to a 3-phase transformer than to three single-phase transformers.

A WPB directive prohibiting the use of single-phase spare transformers probably eliminates the use of spare equipment for the war duration. Even before the WPB ruling went into effect, utilities and other large users realized that power transformers rarely fail. They therefore collected their spare transformers and made them up in new banks when required, purchasing transformers needed to complete installations. The WPB directive also urges use of 3-phase transformers for 3-phase loads.

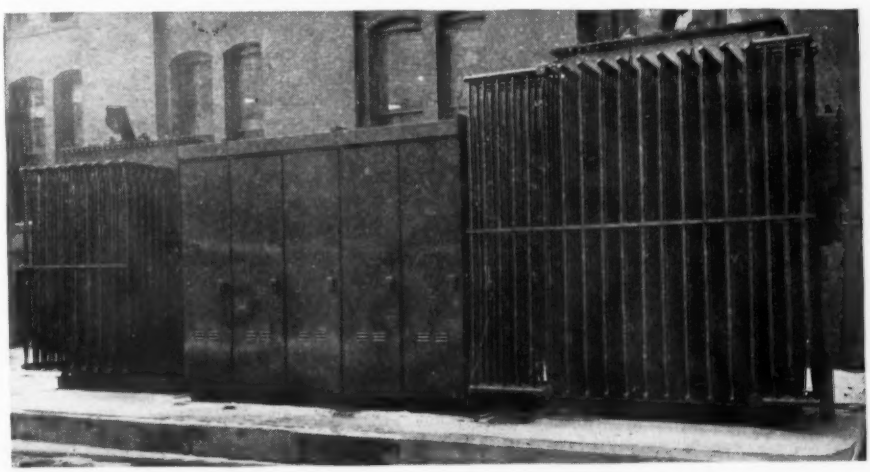
Open-Delta Operation

Open-delta operation of two transformers in a single-phase bank of three is rarely done in an emergency. To do this, the three transformers must be connected delta-delta before two of them can be operated open-delta. Most transformer applications are connected Y grounded on the low-voltage side. Even though winding failures in power transformers are rare when they are properly maintained, bushing failures occur occasionally. Three single-phase transformers have twice the number of bushings of an equivalent 3-phase transformer.

When a plant is producing vital war material, partial reserve capacity in a master-unit-substation transformer bank may be required. In such cases, rather than a bank of single-phase transformers, use a double-ended unit substation—that is, one with two 3-phase transformers. Each transformer would have a self-cooled rating equal to one half

(*Continued on page* 148)

To increase reliability, this double-ended unit substation uses two 3-phase transformers, one at each end of the outgoing low-voltage switchgear assembly



The Old Chief

Active Volcanoes

Another in the series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario. Writing of the inspiration of the past, he has captured much of the human side of engineering that lies beneath the maze of power plant costs and the wavy lines on paper disks

"NEVER use a pipe wrench on brass!"

▶ THERE WAS A TIME in the old plant's history, a time which now seems very remote, when our friend, the Old Chief, contrived to keep things rolling by means of blistering broadsides which were delivered to all and sundry who, in his opinion, were not toeing the line. This was the accepted method generally employed to make the wheels go round in industry. Slowly but surely the times changed and many unpleasant duties that were part of the foreman's job changed with the times. Labor-saving devices came along one after another and made the driving of men unnecessary.

Through the years the Old Chief became mellow and substituted more or less kindly lectures for the blasting-to-Hades methods of former years. However, there were still some active volcanoes in the land, that is to say, minor offenses that he would never condone. One was using a pipe wrench on a machined surface or on brass in any shape or form.

The culprit would be informed promptly that there was a wrench for every standard size in the shop and that there was a stated use for every tool. He would be told that one did not use a pickax when a screw driver was indicated or a sledge hammer to repair a wrist watch. Personally, the Old Chief would as soon use a hammer and chisel to cut a slice of bread as use a pipe wrench on any machined surface.

The stage was really set for an honest-to-goodness verbal explosion whenever the Old Chief found some of the men calmly walking about minding their own business, quite oblivious to some dangerous condition that was either crying out a warning or staring them in the face. I recall one morning when an aroused and red-faced Old Chief barged into the office. "Listen," he said, "You know those three monkeys that 'see no evil, hear no evil, speak no evil'? Well, all three are working for me down in the pump room."

A Drip Stopper

I afterwards learned that the Old Chief had from a long way off heard a banging coming from the direction of the pump room. The men on duty admitted they had heard the noise for some days, and added the silly statement *that the men they relieved had said nothing about it.*

The noise was traced to the heat-exchanging coils in a large hot-water tank, and it developed that someone had been bothered by a leak coming from the vacuum-relief valve. This person had stopped the drip by removing the valve, had capped the pipe and either forgotten to complete the repair of the valve, or thought it of no great importance. The Old Chief cornered the culprit and asked him whether he knew the function of the valve in question. Did he know the psi on the outside of the copper coils? Did he know how many inches of vacuum there would be inside the tubes when the automatic control cut off the steam? Did he know the cost to the factory during the rush season by an outage of that tank at that time for coil replacements? Did he think the insurance on that particular pressure vessel would be worth more than two cents, in the light of such boneheaded malpractice?

Incidents like that would put the Old Chief on edge for days. Out of a blue sky he would remark, "That guy reminds me of a fellow down home who wedged a 4 x 4 between the ceiling and the lever of an old safety valve to keep it from chattering. It stopped chattering, and after the explosion they found his head and no one was surprised when they discovered that it was empty."

Knock, Knock, Who's There?

A water hammer in one of the lines would not bother or concern some peaceful-minded engineer until the Old Chief with pointed remarks drew his attention to a blast trap that had, like the culprit himself, "quit working." Then would follow a cleaning out of drip pockets, separators and traps.

Still grumbling about men who paid no attention to warning signs and sounds, he would declare, "I honestly believe that if a fife and drum trio marched through this plant, some of the boys would never hear it—if hearing it might cause them to do a little thinking."

COMPRESSED AIR for War Production

By E W FELLER, *Assistant Editor*

IN TODAY'S JOB of pouring out war materials faster and ever faster, compressed air holds down a front-line post. Air powers the rivet guns that sew airplane frames together, the portable grinders that finish castings and welds, the chipping hammers that beat a steady tattoo in shipyards and war plants. These are familiar jobs for compressed air, but a host of new ones have been added. Today, compressed air powers bench and machine vises, operates machine clutches, clears away chips, ejects finished parts, provides the "lift" in versatile hoists, and drives the new ultra-high-speed hand grinders used on many precision jobs.

More air for old jobs, plus lots of air for new jobs—that's why compressed-air load often increases faster than steam or electrical demand, why compressed-air supply is a critical factor in maintaining maximum war production.

Responsibility for air supply lies with the power engineer. When demand approaches or exceeds supply he must decide what to do, and do it. In essence, he faces three choices: (1) to eliminate waste in distribution and use, (2) to increase output from existing compressors, or (3) to add more compressor capacity. War conditions dictate making his choice in just that order, with new compressors a last resort when all other steps to meet demands fail.

To help the engineer win the war on air waste, boost compressor capacity or select a new compressor if absolutely necessary, POWER presents its 43rd special section, "Compressed Air for War Production." With time-saving brevity it shows what happens when air is compressed, describes compressors and auxiliary equipment, and tells how to operate and maintain the compressed-air system for best results.

How Pressure and Heat Affect Air

Atmospheric air is a mechanical mixture of gases, principally oxygen and nitrogen. It thus consists of individual molecules of these gases, widely separated, which travel at high velocity and, as a result, hit inclosing surfaces and produce pressure. Temperature is directly related to average molecular speed. High speed means high temperature; low speed, low temperature.

When heat is added to a fixed volume of air, particles move faster and temperature rises. Again, if a piston compresses air confined in a cylinder, the moving piston delivers energy to the molecules, just as a bat does to a baseball. Resulting higher molecular speed shows up as high temperature.

Compressing air is nothing more than forcing a given volume or weight of molecules to occupy less total space by squeezing them. With volume reduced and travel restricted, molecules hit on the sides of an inclosing vessel with greater frequency, which shows up as increased pressure.

To sum up, pressure of a given inclosed quantity of air can be increased by increasing temperature, reducing volume, or both.

Two common theoretical standards of comparison are *isothermal* and *adiabatic* compression. Isothermal means constant temperature. If perfect cooling could keep air at the starting temperature throughout the stroke, compression would be isothermal, an ideal condition requiring the least power, as shown in Fig. 3, page 85.

Adiabatic Compression

At the other extreme is the so-called adiabatic compression, which exists when cooling effect is entirely eliminated. During such compression work delivered by the piston shows up as a steadily rising temperature. Higher temperature of air proportionately increases pressure at each point in the stroke, and this in turn increases the power requirement. The extra power shows up in the delivered air as higher temperature, but it has no value if air cools in storage tank or in transmission.

In practice, compression is never exactly isothermal or adiabatic, but in between them. Good design and operation get further away from adiabatic and closer to isothermal, chiefly by better cooling arrangement; more and colder cooling water; and multi-stage compression with intercoolers between stages. The latter is the most effective.

For a given temperature, one cubic foot of air can hold only a definite weight of moisture. Thus, if a given volume of completely saturated air is compressed to one-fifth and then cooled to initial temperature, moisture-holding capacity decreases four-fifths, and as a result 80% moisture must condense out. Here, cooling to initial temperature destroys the air's ability to hold the initial quantity of vapor. As long as the heat of compression remains, air can hold all initial moisture because every 20-F rise doubles the air's moisture-carrying ability. Psychrometric

charts, such as POWER's Data Sheet No. 19, show relative atmospheric humidity for various temperatures.

Of the several kinds of compressors, the most easily explained is the reciprocating machine. Fig. 3 shows in cross-section a double-acting compressor with piston, piston rod, inlet valves *A* and discharge valves *B*.

Here is what happens when piston starts its stroke from the right and moves toward left: As it moves, air remaining in clearance space under discharge pressure expands, aiding piston's movement. As soon as this air expands below discharge pressure, the discharge valve automatically closes. Continued piston movement permits this entrapped air to expand. When it expands to a pressure below that of outside atmosphere, new air enters. This free air continues to enter until piston reaches end of suction stroke, leaving cylinder filled with air at atmospheric pressure.

Reverse stroke of piston to right starts compressing entrapped air, forcing inlet valve closed. Piston movement continues to reduce air volume until the resulting pressure forces discharge valve open against receiver pressure. Air then flows into the system during remainder of stroke to right. As travel reverses, air remaining in clearance space re-expands.

An ideal compressor would take in, at maximum atmospheric pressure, a cylinder full of air that did not absorb heat as it entered. The piston would then compress air to its final volume and pressure, without any increase in temperature, and force entire volume of air from the cylinder. This ideal condition does not occur in practice. Internal pressure must be below atmospheric or air will not enter. Travel through hot inlet passages raises air temperature, and this increases internal pressure and reduces total weight of air flowing in. As compression takes place, rise in air temperature builds up pressure prematurely and extends length of time piston must act against this pressure in forcing air from cylinder. Another loss occurs because the air that occupies the clearance space cannot be forced out by the piston and replaced with new air.

Indicator Diagram

Changes in pressure and volume occurring in one end of cylinder can be followed on indicator card, Fig. 3. Distance *L* represents volume displaced by piston during one stroke. Cylinder is filled with air at atmospheric pressure, and this confined air's pressure gradually rises as piston, starting its stroke to the right at *G*, reduces volume until a pressure *H*, slightly above receiver pressure, builds up. Completing the stroke, piston forces air from cylinder. Line *H-J* represents this expulsion.

Upon completion of stroke, clearance space remains filled with air at pressure *J*. The larger the clearance space, the more air it holds and the farther piston must move to the left before this confined air can expand to below atmospheric pressure. For this reason, manufacturers keep clearance space as small as mechanical conditions allow.

Clearance space, although reducing capacity of compressor, represents little loss of mechanical power because most of the energy used in compressing air trapped in this space returns to help move piston during the expansion period on the return stroke.

In present day single-stage reciprocating machines, compression takes place nearly adiabatically, wasting some energy in the heat of compression. Air temperature rises gradually; consequently it is too little different from that of the surrounding cooling medium in early part of stroke to permit rapid dissipation through cylinder's thick cast-iron walls.

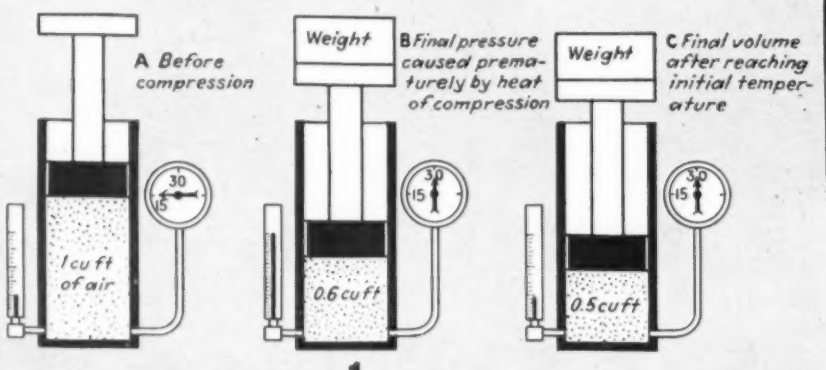
Temperature differential increases during the later period of compression but as air soon passes from cylinder, no great amount of heat transfer takes place. Water jacketing brings compression curve somewhat below adiabetic, but excess pressure required to force air through valves makes the work of compressing and discharging air close to that calculated on assumption of adiabatic compression.

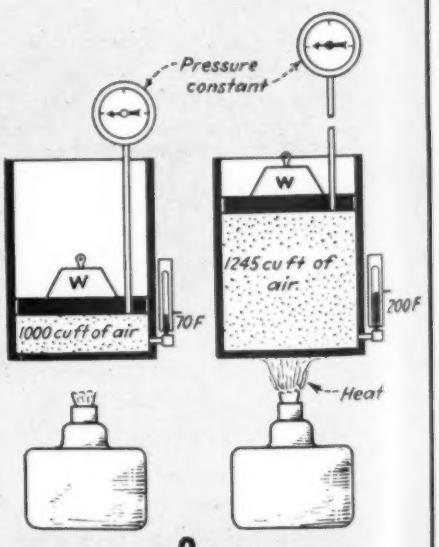
As ability of air to hold moisture diminishes with increase of pressure and increases with a rise in temperature, we can expect no moisture precipitation in air as it leaves compressor. However, since air temperature in receiver and piping soon drops to that of surrounding atmosphere, we can expect condensation. If carried along with the air, condensation destroys tool lubrication, causes water hammer in pipelines and, in freezing weather, may burst pipes. Air containing con-

HEAT CAUSES EARLY PRESSURE DURING COMPRESSION OR MORE VOLUME AT CONSTANT PRESSURE

(1) Compressing one cu ft of air from 15 psi, *A*, to 30 psi reduces volume one-half, *C*. *B* shows how temperature rise during compression affects the volume

(2) At constant pressure, volume varies directly with abs temp. 1000 cu ft of air at 14.7 psi and 70F heated to 200F expands to (660 ÷ 530) × 1000 = 1245 cu ft





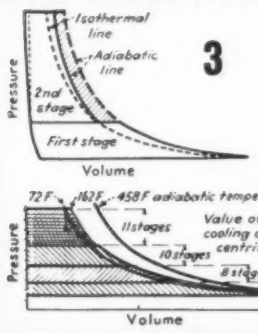
densed moisture cannot be used to blow dust from electrical machinery.

Since cooling the air causes moisture to condense, good practice dictates that this cooling take place immediately so that condensed moisture can be removed before air reaches distribution system. A water-cooled heat exchanger, or aftercooler, connected in the compressor discharge cools the air. Condensed moisture flows to drain pockets where it can be removed by automatic traps or by drain valves.

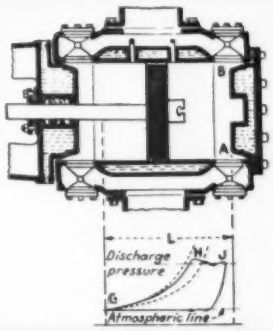
When compression ratio in any one stage exceeds four or five, air temperature rise becomes excessive, resulting in appreciable power loss. Dividing the compression into two or more stages, with intercooling between, eliminates part of this loss. Assume a final pressure of 100 psi abs, reached in one stage of compression; discharge temperature would be approximately 430 F. The same total compression ratio, carried out in two stages, results in maximum temperature in each stage of 250 F if intercooling lowers temperature of first-stage discharge to its initial value. Dividing compression into stages gives a reduction in power loss only if cooling takes place between stages. Closer approach to ideal isothermal compression by this temperature reduction gives the real reason for staging.

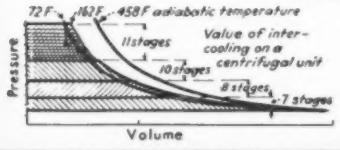
As atmospheric density decreases at high altitudes, a compressor takes in a smaller weight of air at each stroke. Because of lower atmospheric pressure, part of the compressing stroke is occupied in compressing air of this density up to atmospheric pressure at sea level. As temperature increases with ratio of compression, more heat results at high altitudes than at sea level when compressing to a given pressure.

WORK DIAGRAMS SHOW THE ADVANTAGE OF INTERCOOLING



(3) Hatched section represents power saved by intercooling between compression stages





Atmospheric Pressure

This high temperature temporarily increases air pressure while under compression, and more power is required to compress and deliver a given quantity of air. Relationship between compressor output and barometric pressure can be expressed simply. Consider a compressor operating at sea level compressing to 70 psi gage pressure, or a compression ratio of 6. Put the same compressor at 10,000 ft elevation and have it compress to 70 psi. At this height, with atmospheric pressure of 10 psi, compression ratio is 70+10=80 psi and 80÷10=8. At sea level, compressor discharges 1/6 cu ft for every cu ft of intake and at higher altitudes it discharges only 1/8 cu ft.

When considering the weight of air use this equation: 0.37 x weight (lb) x temp abs=vol (cu ft) x psi abs.

Effects on the air itself remain the same regardless of whether compression takes place in a rotary, centrifugal or axial-flow compressor.

Axial-flow compressors resemble a reaction steam turbine where each stage consists of a row of moving and stationary blades held in grooves on the hollow-forged rotor and in the casing. Operating at high speeds with multi-staging, this compressor supplies large volumes of air up to 60 psi in a steady stream free from pulsations. Having no internal rubbing surfaces that require lubrication, the machine delivers oil-free air. Like centrifugal machines, this compressor does not build up dangerous pressures.

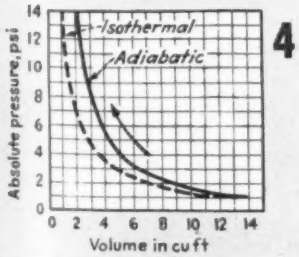
Centrifugal compressors (POWER, Jan 1942, pg 81) running at high speed, compress air by centrifugal force and are particularly suited to handling large volumes of air for blowing furnaces and sewage disposal.

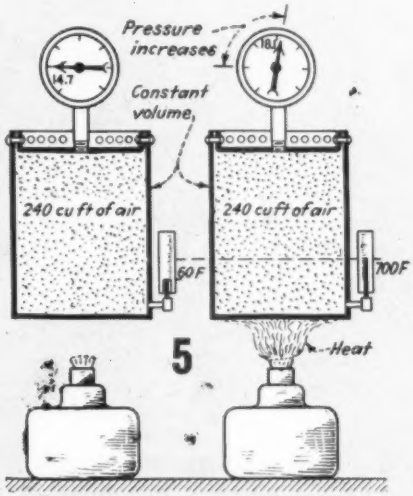
Rotary compressors (POWER, Feb 1942, pg 114) running at moderate speed furnish large volumes of air also for more or less special purposes, as well as overlapping the reciprocating field to some extent.

Over-all economy of an air-compressor unit depends on: (1) mechanical construction—size and proportion of bearings and wearing surfaces; lubricating system and general design of parts; (2) length and volume of ports in air cylinder; (3) cooling surfaces in water jackets and intercoolers, and temperature of cooling water; (4) surrounding conditions—altitude at which machine is operated and atmospheric temperature; (5) clearance spaces and slippage; (6) economy of power end.

REDUCING VOLUME OR APPLYING HEAT INCREASES PRESSURE

(4) Isothermal (constant-temperature) compression takes least power. Adiabatic compression takes more power because of temperature rise





(5) At constant volume, pressure varies directly with absolute temperature. Given 240 cu ft of air at 60F and 14.7 psi. When heated to 700F final pressure is $\frac{460+700}{460+60} \times 14.7 = 32.8$ psi abs

COMPRESSORS

Of the several air compressors, the reciprocating-piston machine is most widely used. Its most common type is *horizontal* although many *vertical*, *V-* and *L-angle* machines are built. The terms horizontal and vertical explain themselves. Angle machines, which have cylinders mounted at a 45- or 90-deg angle with each other, may have one cylinder vertical and the other horizontal, or all cylinders at some angle from horizontal. V-angle and vertical machines are installed in limited floor space; horizontal units need more floor space, less headroom.

Arrangement of cylinders further divides compressors into straight line, or *tandem*, and *duplex* machines. Duplex arrangement places cylinders in parallel at opposite ends of crankshaft. Double-duplex units form an H, with a cylinder at the end of each leg and the driving unit as crossbar. Duplex machine cranks at a 90-deg angle reduce power pulsations to a minimum.

Intermittent Requirements

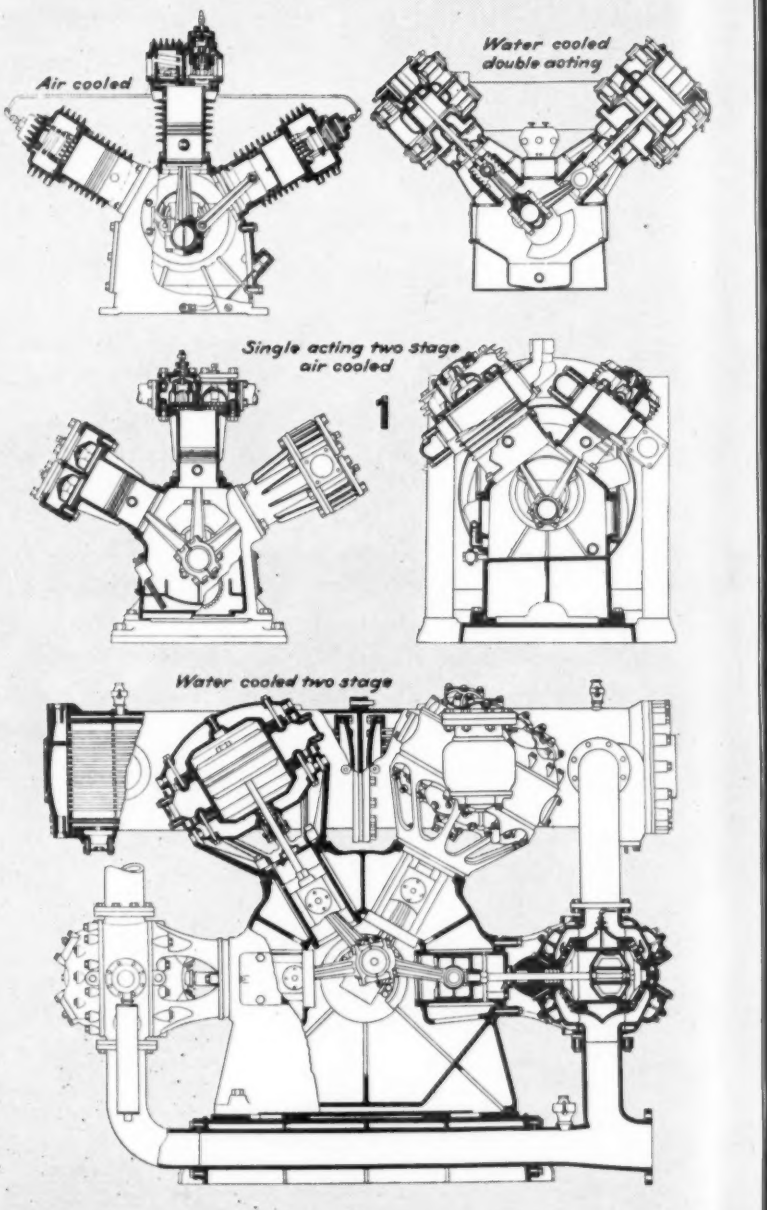
Stationary construction follows all the designs discussed; portable and semi-portable styles are mostly V-angle and vertical. The semi-portable unit is usually mounted on skids, which permit moving it at infrequent intervals. The portable unit, mounted on its own truck, can be moved easily without special hoisting facilities. When compressed air is needed intermittently, or its uses are widely separated, portable or semi-portable machines may prove more economical than an installation with several long distribution lines.

Piston action within a cylinder determines whether a unit is *single* or *double acting*. Practically all stationary units compress air during both the forward and the return strokes of piston. But the majority of portable and semi-portable machines have single-acting construction. Other conditions being equal, and disregarding piston rod volume, the double-acting has twice the capacity of the single-acting.

Single- and double-acting machines compress air in one or more stages, which classifies them as *single-* or *multi-stage* compressors. Choice between the two depends on such widely varying factors as size of compressor, ratio of compression, discharge temperature limitations, cost of power, continuity of service, and relative permanence of installation. The Compressed Air Institute suggests a general dividing line, based on sea-level atmospheric intake pressure, as follows: Below 60 psi, use single stage. For 60-100 psi, use single stage below 300 cfm, and two stages for larger sizes. Normally, cylinders of a multi-stage compressor are mounted separately and distinguished by difference in size, but occasionally multi-stage compression takes place inside one common casing, giving the appearance of only one cylinder.

Internal design of cylinders varies: Some carry inlet and discharge valves, while others have valves in extensions cast integral with cylinder heads. The latter then form part of the cylinder barrel but do not serve as sliding surface for the piston. Casting the cylinder with triple walls provides space for cooling-water circulation, air intake and discharge chambers, and clearance pockets for load control. Cylinder heads having double walls form water chambers, sometimes connecting with those in the cylinder walls for circulating cooling water. Many of smaller size, as well as numerous portable and semi-portable compressors, use atmospheric air circulation for cylinder cooling. Fins cast integral with cylinder furnish additional radiating surface. Circulation

SINGLE- AND DOUBLE-ACTING ANGLE COMPRESSORS



of cooling water between cylinder walls or of air over the cast fins (in an air-cooled machine) removes only a small part of heat from the compressed air, but serves to keep cylinders and valves at reasonably low working temperature.

High-Speed Valves

For today's higher rotary speeds, valve construction is much improved over the sluggish poppet valve of older slow-running machines; the heavy valve's weight alone caused final pressure within cylinder to rise considerably above that in the delivery main. Mechanically operated valves have also disappeared, except the lighter ones that require little operating power. One has the gasoline engine poppet valve and camshaft arrangement for the inlet valve. Most designs today favor flat steel-plate valve construction with plate shape the only difference. Shapes vary; some valves have circular plates; others, several flat concentric rings; still others, rectangular strips. Some plates are held in place by separate springs, others by the springiness of the plate metal; still others are held loosely in place without spring action. All the valves mentioned are carefully designed for light weight, with plenty of passage area; this reduces velocity friction and pressure loss, and also lowers the pressure needed to force valve open. Valve size and arrangement affect total clearance volume.

Piston ends also must conform to cylinder shape to keep clearance volume at a minimum. This sometimes means that a piston has tapered ends instead of being flat. Metal rings fitted in grooves around the cast-iron or semi-steel piston circumference prevent leakage between piston and cylinder walls. Pressure requirements determine the number of rings; many manufacturers use 1- or 2-piece snap rings while others use segmental section rings with internal expander. Two-piece snap rings sometimes ride on an internal expander. Taper or step joints prevent leakage past ring ends. Clearance between ring and groove, approximately .003 in., just suffices for the ring to drop into the groove of its own weight. Material for rings varies; the majority are cast iron or graphitic iron. One manufacturer recommends a copper-lead ring to operate compressor with minimum lubrication. Auxiliary copper-lead rings installed with regular rings serve to polish the cylinder walls.

Special Piston Rings

When compressors must furnish oil-free air, no oil is allowed to enter the cylinder; rubbing friction between piston and cylinder is reduced by replacing metallic piston rings with carbon ones. In one design the piston itself is supported by a third carbon ring; in another, the piston rod passes through piston and front head to a sliding bearing outside. The piston fitted with carbon segmental rings then rides between the main crosshead and sliding bearing.

To prevent air leakage, openings in cylinder head for piston rod's passage must be fitted with packing; operating pressure determines the amount. Some manufacturers use metallic or carbon packing, others prefer fibrous. One authority cautions against the rapid scoring tendencies of hemp packing.

Performance of metallic piston-rod packing depends on mechanical fit between packing rings and rod. Because metallic packing damages easily, follow instructions religiously when installing, inspecting or repairing it. Packing, piston rod and stuffing box must be absolutely clean to prevent injury to packing rings. Identification marks on individual rings assure correct assembly. Markings must coincide when placing packing on rod.

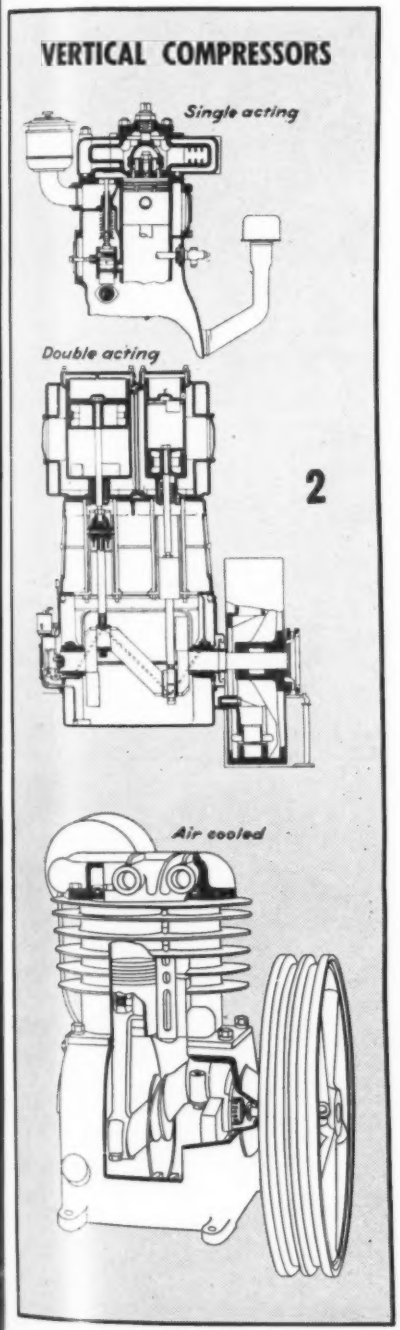
For best results with metallic packing, finish piston rods true and parallel, preferably by grinding. Remove scores, scars and shoulders from old rods by stoning or grinding before replacing fibrous packing with metallic. Adequate lubrication is essential; the oil also helps to seal against air leakage. Wiping rings, formed from carbon segments held together by garter springs, or circular metal rings, seal against oil leakage from crankshaft and crosshead chamber.

Crosshead Details

The crosshead, a box-shaped casting, serves as a sliding joint between piston and connecting rod. Bronze or babbitt-faced shoes on top and bottom of crosshead slide in heavy guides and prevent transmission of bending strains to piston rod. Shims or wedge joints between crosshead and shoes adjust wear between shoes and guides. A heavy tapered pin fitting a tapered hole through crosshead-spacing ribs forms a bearing for connecting rod.

Connecting rods, usually solid-end forgings, generally carry a 2-piece solid bronze crosshead bearing with babbitt-faced castings serving for crank-end bearing. Adjustable metal wedges, one for each bearing, take up any clearance caused by bearing wear. Some rods carry both wedges on the inner bearing pads; others have the crosshead-end wedge on the inside and the crank wedge against its outer pad. The connecting rod produces reciprocating motion of piston by a crank connection to the main shaft. Compressor style determines whether this connection is a U-crank or a counterweighted disk and pin. Compressors having two cylinders in line operate with one connecting rod and crank by connecting one piston through stretcher rods reaching past the crank to the main crosshead. The connecting rod then connects this main crosshead to the crankpin.

Crankpins are heavy forgings pressed in place in the crank disk. Disks, although sometimes not circular in form, always carry a counterweight to dampen reciprocating action. Multi-cylinder compressors using more than one crank have cranks placed at angles of less than 180 deg with each other. This pre-



vents compression occurring simultaneously in all cylinders and reduces load pulsations; it also minimizes main bearing shock.

The crankshaft rides in roller or split-block bearings supported by the main frame. Split bearings consist of two or sometimes three separate babbitt-faced castings. One 3-piece design uses a bronze bottom section and babbitt-faced side pieces. In practically all machines a movable wedge provides adjustment for bearing wear. Spacing shims located between bearing sections prevent movement of the adjustable shoe. Some manufacturers build smooth-faced bearing shoes, others groove shoes for lubricating oil passage.

Lubrication

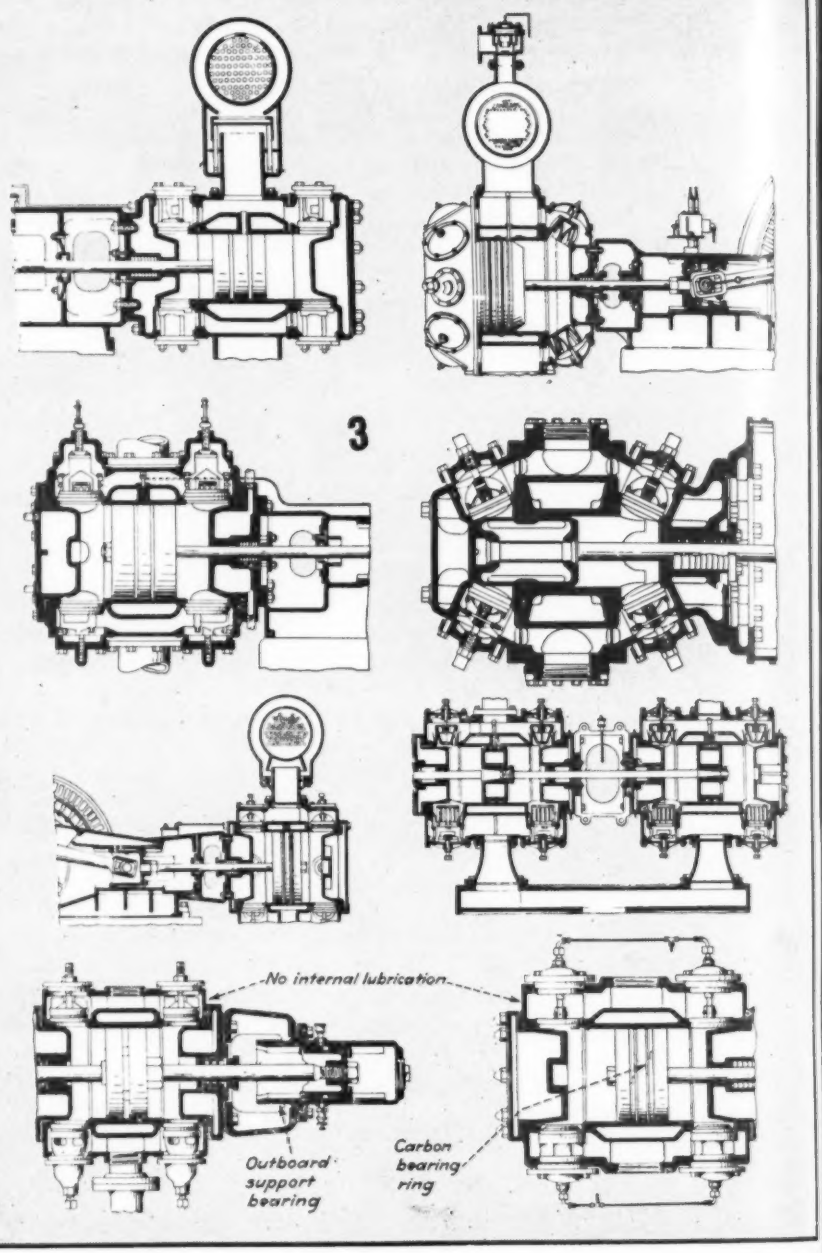
Oil in crankcase or special reservoirs furnishes lubrication for moving parts. Rotation of crank disk splashes oil up and over connecting rod and main bearings by gravity. Some large stationary compressors use a pump to force oil through piping or drilled channels in shaft and crank disk to crankpin, crosshead pin and crosshead guides. Single-acting portable and semi-portable compressors generally use the splash system of lubrication for cylinder walls as well as all bearings. Double-acting machines require a force-feed supply of cylinder lubricating oil furnished by a mechanically driven lubricator.

Pipes fitted with check valves carry the oil into each cylinder; as piston passes, oil gathered up and carried between piston rings serves for lubrication and also helps seal piston against leakage. This lubricator is safe because, being mechanically driven, it feeds oil to the cylinder during operation only, and feed is constant whether machine is running loaded or unloaded.

Load control arrangement varies, but all manufacturers use some form of the simple methods of: (1) holding open inlet valves, (2) closing intake, or (3) opening valves to clearance pockets cast in cylinder walls. When compressor runs fully loaded, a centrifugal or time-delay governor operates the unloading mechanism at a point just under full speed. Unloading control, described later, depends to some extent on method and type of compressor drive.

Although reciprocating compressors give a pulsating load, they can be driven by any of the available prime movers. Driving connection takes some form of coupling or indirect connection, or the driving unit is an integral part of compressor. Most steam and internal-combustion engine-driven compressors are integral constructed units

CYLINDERS AND PISTONS FOR HORIZONTAL COMPRESSORS



operating at from 100 to 500 rpm. Coupled or indirect drive through gears, belts, and chains operated by electric motors, steam turbines or internal-combustion engines serve for compressor running speeds as high as 1500 rpm.

Reciprocating Drive

When reciprocating compressors are driven by steam, gas or oil engines, with a similar pulsating power-impulse characteristic, drive connection must be made so that maximum power input occurs at time of greatest air compression resistance. Otherwise, an excessively large flywheel must be used to furnish momentum for carrying through the compression stroke. Size of flywheel depends on position of driving cylinders and piston in relation to those of compressor. Prime movers, with more than one cylinder and cranks 90 deg apart, bring greatest power impulse in time with maximum compression resistance. Another method keeps cranks together but mounts driven and driving cylinders at some angle with each other. Gasoline-engine-driven compressors connected by flanged couplings have marked flanges to prevent mis-coupling.

A completely equipped air-compressor installation includes accessory units not usually considered a part of the compressor itself. The importance of adding this equipment and its value to the system will be considered next.

ACCESSORIES and UNLOADERS

IN THIS SECTION we consider both accessories for compressors and unloading system design, which depends to some extent on compressor construction, as well as plant needs.

Usually accessories are not included in compressor purchases. Among them are: (1) *Intake filters,* (2) *strainers and separators,* (3) *aftercoolers,* (4) *silencers.*

Filters and cleaners. Dust and other matter entering a compressor cause sticking valves, scored cylinder liners and abnormal wear of moving parts. Passing on into the distribution lines, dirt and grit cause similar damage to tools, valves and contaminate certain process work. Filters on the compressor intake eliminate these troubles.

Viscous-Coated Filter

One type of filter catches dust by passing air past a series of viscous-coated-metal baffles or through closely packed crimped wire. Glass wool packed in frames forms a dry unit convenient for handling, and can be combined in different-sized assemblies. Several other so-called dry types consist of an assembly of pockets formed of wire or wire mesh carrying a special felt cloth. Small-sized filters of the centrifugal type remove dirt by whirling air around the inside wall of a circular-shaped intake chamber.

One self-cleaning filter consists of two endless curtains made from panels of bronze cloth, backed by successive layers of metallic mesh. Front curtain moves down into an oil bath, allowing large particles of dirt to settle to bottom of basin. Emerging from the oil, curtain moves up to act as a second filter, while a compressed-air spray removes excess oil from it. Third filter (second curtain) moves down but does not enter the oil. Continuing around the lower sprocket, another air spray cleans the second curtain as it moves up to final or fourth filter stage.

Another design takes air in through a screened opening and passes it down between two outer walls to strike the oil surface at the bottom. Heavy dust particles settle on the oil as the air continues upward through vane openings; the air whirls faster, throwing dirt and oil into a basin around the side walls. Oil and dirt flow down an inner wall passage and air continues up through the filter cells to the compressor inlet connection.

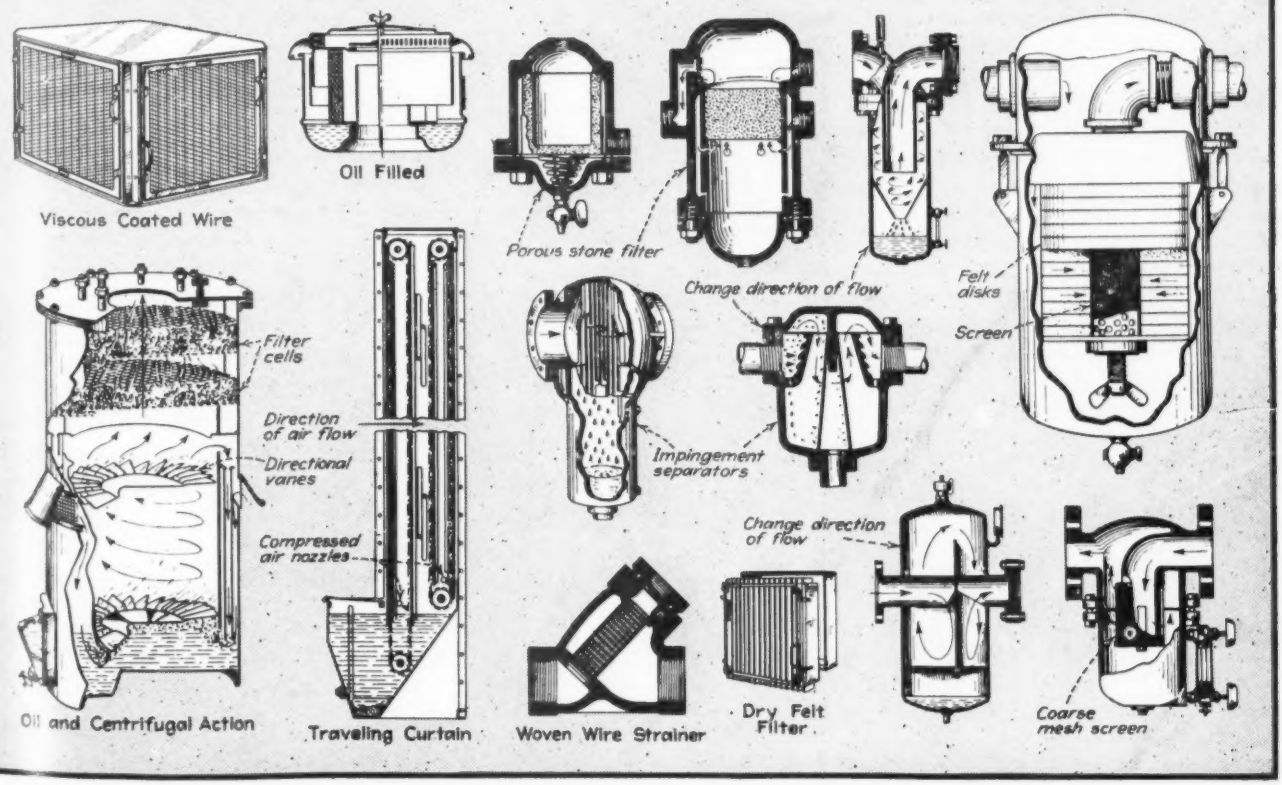
Strainers and separators. Aftercoolers remove excess moisture and oil only in proportion to their ability to lower air temperature. Air leaving the aftercooler still remains saturated; any further cooling causes additional precipitation of moisture.

Remove Moisture and Oil

Devices that remove this water before it reaches tools or process include water legs, separators and strainers. Amount of moisture that can be tolerated determines which of the three devices to use: Water legs and separators remove heavy liquid particles; strainers, depending on internal design, take care of foreign particles and the last traces of suspended moisture and oil.

Separators operate on the principle of centrifugal force or velocity of flow. Changing direction of air flow, while moisture globules continue straight ahead to strike a baffle, or giving the air a whirling motion throws the mois-

FILTERS AND SEPARATORS REMOVE FOREIGN MATTER, SUSPENDED MOISTURE AND OIL



ture particles out of the air stream.

Coolers. They serve (1) to cool the air and condense excess moisture, and (2) when used as intercoolers on multistage units, to reduce total power required to compress the air. Both atmospheric air and water serve as cooling mediums.

Atmospheric air coolers consist of finned tubes to increase the cooling surface. Used only on air-cooled compressors, they eliminate need of a cooling-water supply.

Water, under turbulent flow, swirls in passing through tubes or jacket, and sweeps the warm water away from metal surfaces, replacing it with cooler water; this mixing action continues until the water flows out the discharge. Baffles inserted in compressed-air passages produce turbulence by destroying any tendency for stratified layer flow. These coolers consist of a nest of corrosion-resisting tubes expanded into tube headers supported and enclosed in a steel shell. When the tubes connect to two separate heads, one head floats to permit expansion and contraction of tubes.

One design eliminates the floating head by inserting an inlet tube, leading from one tube head concentrically into a larger discharge tube. The latter, closed at its far end, then connects to a different tube sheet, allowing one end of each tube to float free. Division of the tube nest into groups of tubes passes the water back and forth through cooler several times before discharging it. Bulkheads or partitions cast integral with both shell heads bear against respective tube sheets and serve as circulating pockets for back flow through the next group of tubes.

Unloaders. Load regulation of an air compressor, driven by a variable speed prime mover, consists simply in changing the governor speeder-spring tension automatically. When compressor operates at constant speed, output must be controlled by starting and stopping, or by automatically regulating amount of free air entering cylinders.

Supplies Changing Load

Most compressors supply a changing load and, to hold a constant delivery pressure, machine must be loaded in proportion to air demand. Actual unloading is accomplished by closing the intake; holding open the inlet valve or opening an auxiliary inlet valve; and increasing cylinder clearance.

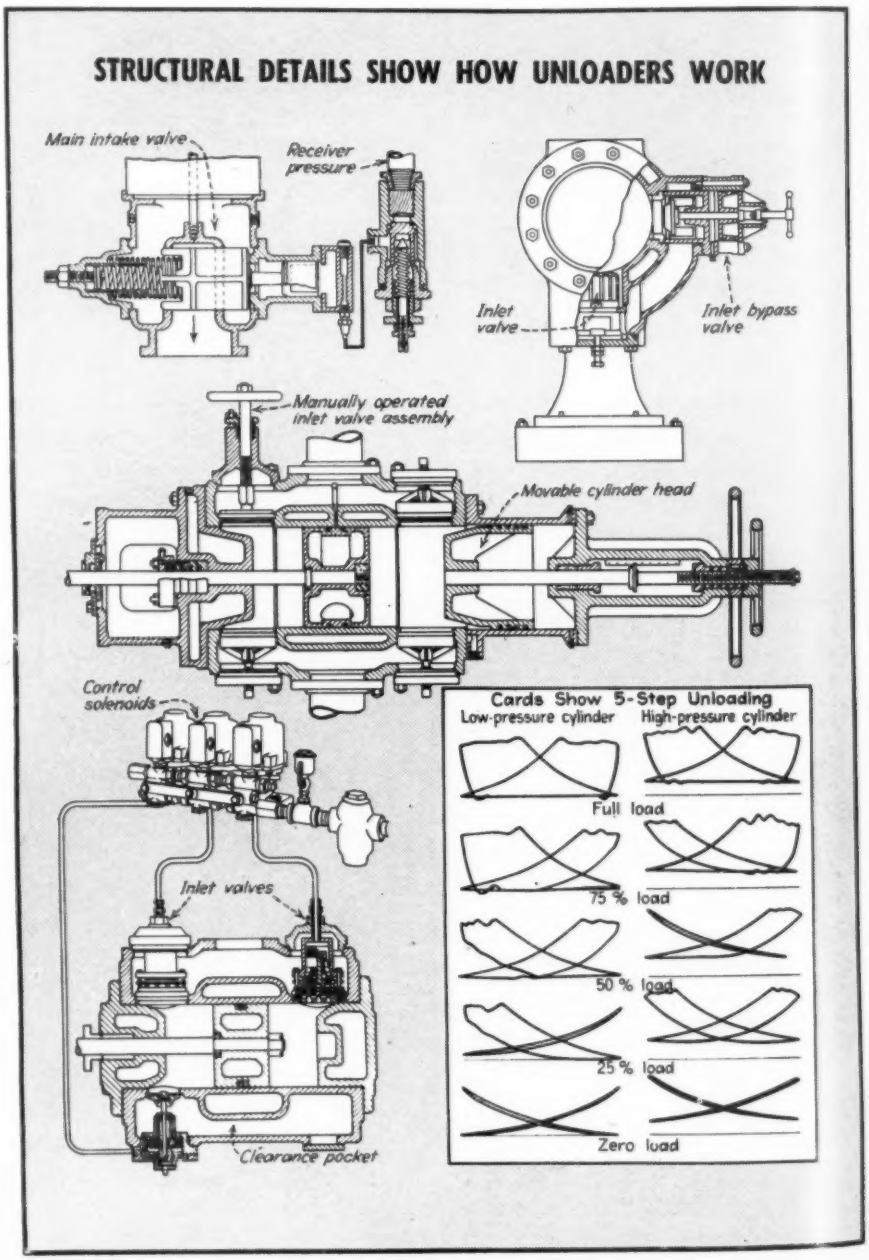
Cylinder clearance is increased by installing an adjustable cylinder head plunger, or by forming pockets in cylinder walls when making the casting. A suitable valve cuts off clearance pockets from communication with cylinder, and the adjustable cylinder head initially occupies position of least clearance. Opening the valve to the clearance pocket or moving adjustable head away from the cylinder bore increases cylinder volume to such an extent that full output can no longer be discharged.

Total closure of the inlet cuts off all air flow, causing a vacuum inside the cylinder and reducing power input to that needed for sweeping piston back and forth against the friction load.

Methods of load control differ; frequently one builder uses all possible methods, adapting a different one for each compressor design. A combination of clearance pocket and open inlet valve control gives a flexible loading on a compressor of some particular size. In another machine, manually raising the inlet valve assembly adjusts the crank end, and the movable cylinder head changes front-end clearance.

Unloading Actuators

Although a few machines incorporate manually operated load control, automatically operated unloading systems, actuated pneumatically by the system air pressure, predominate. Actual operators, the mechanism that forces the valve open or closed, receive actuating force from an air-operated bellows, piston or diaphragm. Either electrically or air-operated valves control the air supply to compressor-valve operators. Over-all governing takes place in a pressure switch or air-relay. Electrical governing usually requires a



separa pressure switch to energize one individ al solenoid-operated valve for each l ading step. Diaphragm and bellows governors move a pilot piston to uncover progressive ports supplying air to each step-control-valve operator. The main governor may be a contact-making bourdon tube; a bellows-operated pressure switch; a diaphragm and weighted arm; a spring-opposed pilot valve; or an unbalanced spring-loaded plunger.

To make an unloading system practical, loading must be prevented until the machine approaches or reaches normal speed. Load release upon interruption of driving power permits unit to coast smoothly to rest. Means to accomplish this range from a centrifugal-operated pilot valve to numerous electrical gadgets. A definite time delay relay, a current relay (for induction motors) or a field relay, connected in the closed field circuit during the starting period of synchronous motors, controls a solenoid-operated valve supplying air to the unloading system. Compressors operating fully loaded on a start and stop basis use the primary controllers just mentioned to prevent loading until full speed is reached and to assure unloading at shut down.

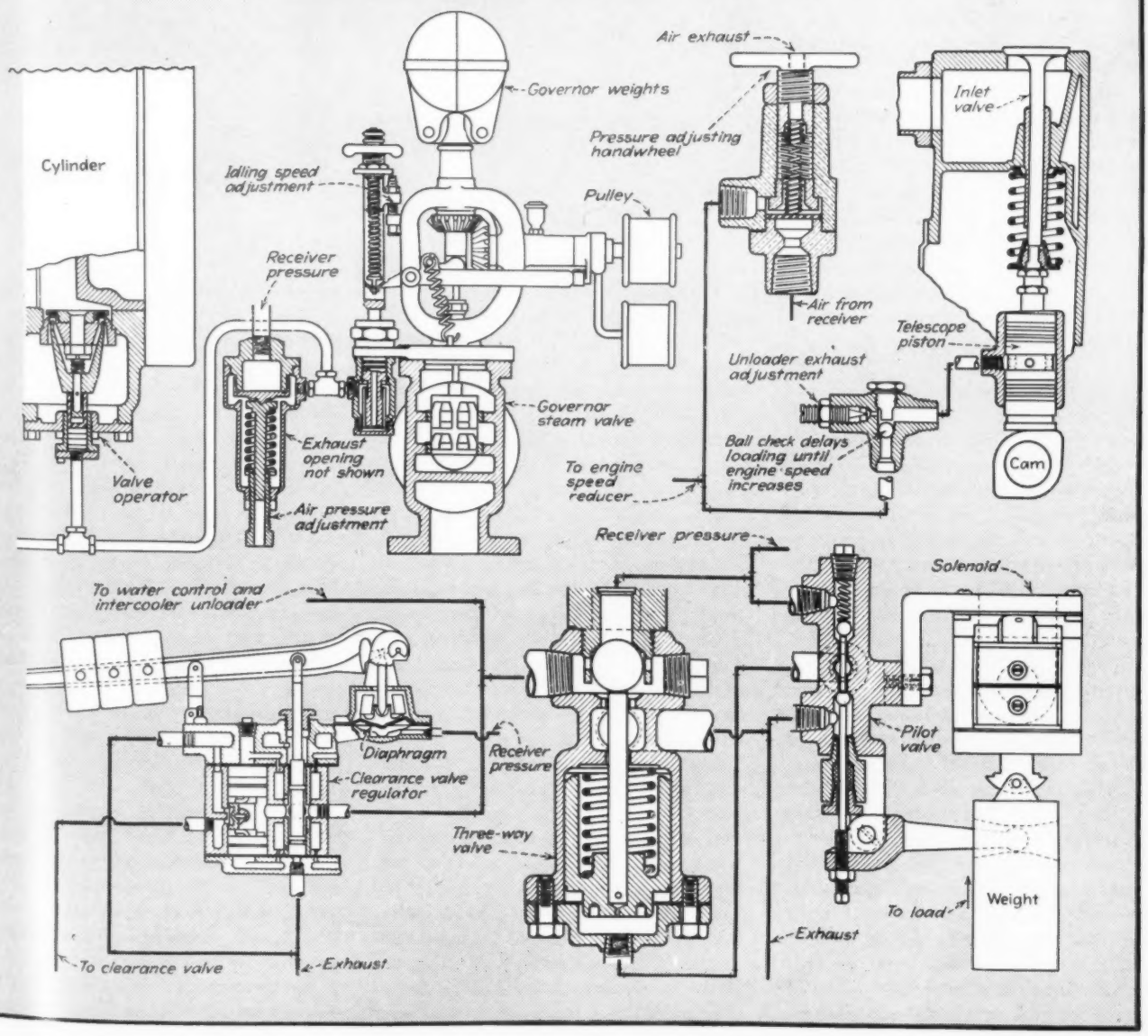
Use Economical Method

Choice of an unloading system depends entirely on the job. As far as power economy goes, the slight difference among the three basic methods is hardly worth considering. When cost of power becomes a considerable item, the compressor should not operate for long periods either partially or fully unloaded. Proper selection of load control, to meet each individual system's requirements eliminates or reduces long periods of part-load operation and permits economical use of receivers.

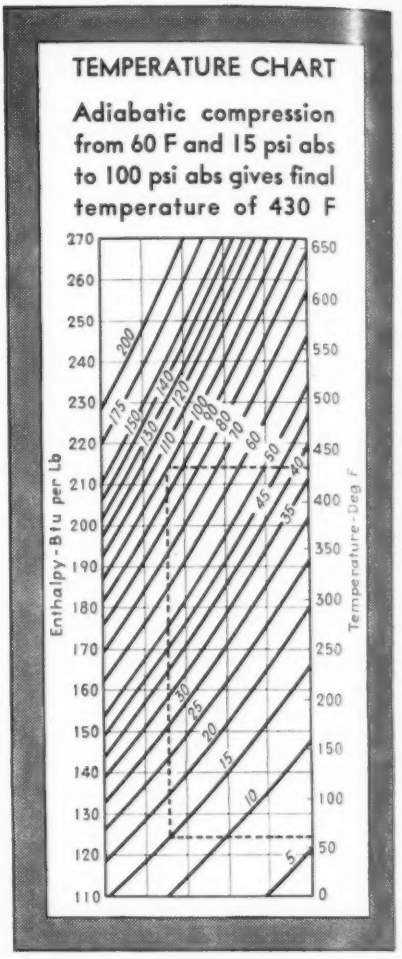
The air receiver, an essential part of every compressed air installation, absorbs compressor pulsations, insuring a steady flow to service lines. Serving as a storage reservoir, the receiver furnishes reserve capacity to care for sudden and unusual momentary demands above the compressor's capacity. Additional cooling of the air and further moisture condensation also takes place in the receiver. Avoid air receivers of questionable or unsound construction; use only vessels that meet ASME Code requirements for unfired pressure vessels.

Protect the receiver against external condensation and arrange supports so that internal corrosion will drain.

SEVERAL TYPICAL METHODS OF CONTROLLING AIR-COMPRESSOR CYLINDER UNLOADERS



OPERATION


TEMPERATURE CHART
Adiabatic compression from 60 F and 15 psi abs to 100 psi abs gives final temperature of 430 F
Enthalpy - Btu per Lb
Temperature - Deg F

EVERY MANUFACTURER gives complete details on the care and operation of his compressors. Write for the instruction booklet that applies to your particular machine. Because of the number of different construction details, we can give only general suggestions in our limited space for safe and economical operation of these machines.

Safety demands a relief valve and pressure gage on both receiver and intercooler: A relief valve must be connected between compressor and stop valve when the latter is used in the discharge line. The receiver's pressure gage checks correct operation of the unloader, while the intercooler's gage shows performance of high- and low-pressure cylinders. A contact-making temperature indicator in the air discharge line sounds an alarm on increase of discharge-air temperature, and a flow switch in the water supply line signals loss of cooling water.

Before operation, take precautions to prevent damage to new or repaired units: See that all essential parts of intake filter are in place; clean foreign matter, such as dust, welding beads and rust particles from intake piping; clean interior of frame, crankcase and oil reservoirs, blowing out oil passages with an air jet and wiping basins with clean rags.

Lubricate All Parts

Next fill all bearings, lubricators and reservoirs; pour oil freely over every moving part of the bearing journals. Good mechanics apply an oil film to all bearings, cylinder walls and piston rods during assembly. Disconnect the oil piping at the cylinder and operate the lubricator until oil issues from the open pipe. Then reconnect it and force a few drops of oil into the cylinder.

Remove all tools and blocking, and inspect for loose parts and foreign objects. Turn on the cooling water and check flow through all jackets and coolers. Trace out the piping; water must enter each cylinder and cooler at such a point that complete filling occurs before any water discharges.

Turn unit over several times by hand to reveal tight bearings and obstructions interfering with its movement. If none appears, apply driving power momentarily and let machine coast to rest. (Unit should be completely unloaded on the air end, with piston-rod packing adjusted loosely.) If no excessive tightness appears in moving parts, unit can run unloaded.

During running-in periods, the crossheads, main and connecting-rod bearings and piston-rod packings may need adjustment. Remove bearings that run hot and scrape to a proper fit. Operate variable-speed machines at slow speed, gradually increasing to full at reasonable intervals; constant-speed machines must come to full speed immediately. Bring unit to rest within five minutes and inspect bearings and other moving parts for heating. Adjust cylinder lubricator to feed not less than two drops per minute.

Breaking-In Run

After a 2-hour run, with inspection stops every 15 minutes, partial load can be applied. Continue periodic inspection stops, increasing load slightly on each restart. Four hours is the minimum for entire break-in run; to do the job right, run several days at light load; run larger machines longer. After operating several hours, remove cylinder heads and inspect lubrication of walls; inspect daily until oil feed is correct. After first day's run, drain and renew bearing and reservoir oil.

Careful polishing of running surfaces during the breaking-in period increases compressor life. After the break-in run, whose importance cannot be overemphasized, operation resolves itself into maintaining a clean air supply, feeding sufficient cooling water, and supplying adequate lubrication.

Mechanical force-feed oiling, splash oiling, gravity feed, or drop oiling provides general lubrication for bearings, crossheads and metallic piston-rod packing. Whatever the method, hold wear to a minimum by keeping oil at proper level in splash reservoir and lubricators. Lubricator is kept clean and bearing life lengthened by changing oil frequently and cleaning reservoirs, pumps, passages and piping.

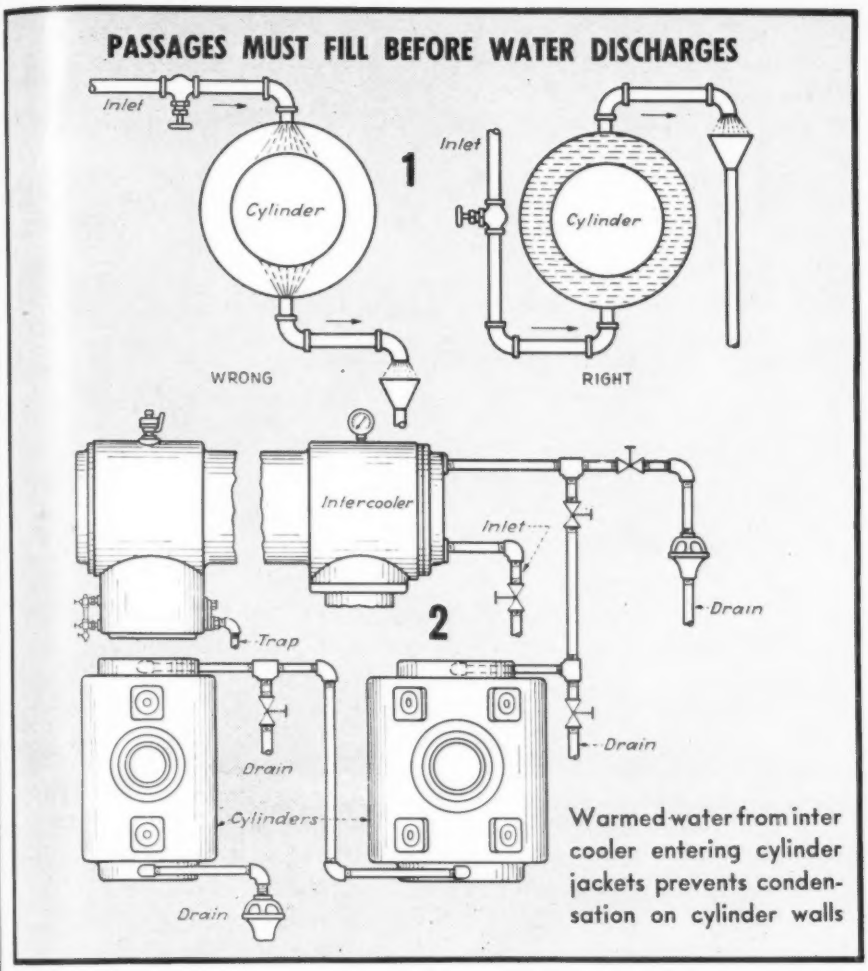
Crankcase oil lubricates cylinder walls and crankshaft bearings of single-acting compressors. Cylinder lubrication seals piston and rings against air leakage and reduces sliding friction and wear. Carrying too high a level splashes excess oil up into cylinder cavities and increases oil leakage past the rings. Continual splashing action of the connecting rods causes aeration of oil with resulting oxidation. These oxidized products accumulate with dust and moisture as sludge which must be removed.

Oil from lubricators is fed to double-acting compressor cylinders. Cylinder oil-feeding rates depend on compressor size. Approximate rates are helpful, but the only accurate guide to the amount of oil to feed is an inspection of cylinder and valves. If they carry enough to make the metal look wet or to leave a film on the fingers after wiping them across the cylinder surface, lubricator is properly set. Remember that oil normally carried between piston rings drains down on bottom of cylinder during extended shutdowns. Excess oil in the compression chamber of a single-acting machine, lubricated by crankcase splash oil, indicates worn and leaking piston rings.

Use Good-Quality Oil

Buy a grade of cylinder oil recommended by the compressor manufacturer. Don't overfeed because excess oil, in the presence of concentrated oxygen, oxidizes rapidly.

Spontaneous combustion may then cause internal fires or, if ignition tem-



peratures are reached, explosions. Internal deposits sometimes result from dust and dirt in the intake air and not necessarily from excess oil. Laboratory tests show that in a well-cooled cylinder only about 10% of a good oil evaporates, or the equivalent of approximately 0.90 ounces of carbon during one year's operation of a large compressor.

If heavy deposits form, check intake air and oil. In selecting oil, flashpoint is not all-important. This is the temperature to which oil must be heated to give off vapors in sufficient quantity at atmospheric pressure (flashpoint increases with pressure) to produce an inflammable mixture with air. Amount of oil evaporated during flash test is too small to measure. Slow evaporation takes place at any temperature and rate of change from liquid to gas depends on time, temperature and chemical composition. Laboratory tests show that evaporation rate of a high-grade compressor oil is 0.0004 grams per square centimeter of exposed surface when kept at 250 F five hours.

This theoretical evaporation cannot occur under normal operation because of water jacketing, cooling effect of intake air, relaying of a new oil film at each piston stroke and the fact that high temperatures occur only toward end of stroke. Since the discharge valves, being in the path of the hot discharge air, are the unit's hottest part, oil evaporated on compressor walls could not condense on the hot valves. Liquid oil on the hot valve surfaces proves that no great amount of oil leaves the cylinder as a gas and that carbon deposits come from this liquid oil adhering to the valve. Leaking discharge valves quickly result in increased temperature which quite possibly can exceed the highest flashpoint of any lubricating oil. This causes the carbon deposits to become incandescent and to ignite an explosive mixture formed of oil vapors from the carbon and excess oil.

Carbon Formation

High-flashpoint oil actually may be detrimental to lubrication because it is necessarily heavy bodied. As a result, it forms more objectionable carbon deposits than a lighter-bodied oil of equal quality. Heavier-bodied oil also tends to catch and hold more dust particles and is more sluggish in distribution. The comparatively low cylinder-wall and oil-film temperature eliminates need of a heavy-bodied oil for lubrication. Most important point is high quality. The oil must not contain elements tending to give off highly explosive vapors even above ordinary air compressor temperature, nor break down and form gummy deposits. Oil fed to a compressor cylinder does not burn as in a combustion engine and only a negligible portion vaporizes; some atomized oil passes into the aftercooler and receiver, the remainder lying in cylinder's clearance pockets.

An explosive oil-vapor mixture can form from lubricating oil only when temperature is abnormally high. Normal air discharge temperatures from the compressor are well below the flashpoint of air cylinder oil, particularly since flashpoint rises as applied pressure increases.

High Internal Temperature

Excessive temperatures result from one or more of these defects: Leaking discharge valves; inadequate supply of cooling water; cooling-water temperature too high for proper transfer of heat from air to water; intercoolers and jackets blocked with dirt, mud and scale, preventing absorption of heat by the water; broken air baffles in intercoolers permitting the air to short-circuit to the discharge with little heat removal; partitions not tight in waterheads of intercoolers, permitting cooling water to short-circuit between inlet and outlet connections without passing through all intercooler tubes.

Another possible cause of high air temperatures are oil and gummy deposits that adhere to intake valves. A partial obstruction in the intake, such as a partly open valve, prevents full air flow into the cylinder; it is then filled with air below atmospheric pressure and a higher ratio of compression takes place with attendant higher operating temperature.

Eliminate possible explosions by: high-quality oil in correct quantities; frequent cleaning of valves, clearance pockets, pipe lines and receivers; sufficient cooling water supplied to compressor and coolers.

Cooling water circulated through cylinder jackets helps maintain an oil film by holding cylinder temperatures below the oil vaporization point. Cooling action in intercoolers reduces the power needed for compression and causes moisture to condense. Always turn on a liberal amount of clean cooling water before starting the compres-

sor. The table gives recommended amounts for cooling purposes.

Water that carries sediment or scale-forming material soon clogs pipes and cylinder water jackets, causing high air temperatures. Scored cylinders and cracked cylinder heads may result from lack of cooling water when a machine starts. Water should discharge through a sight-feed glass or into an open funnel in plain sight of the operator. Install strainers on the main water line if water comes from a stream or other source containing leaves and trash.

Extremely cold cooling water flowing freely through cylinder jackets causes condensation on cylinder walls, which destroys the lubricant and causes rapid wear. One suggested piping arrangement feeds cold water through the intercooler to the low-pressure cylinder and then to the high-pressure cylinder. Because the intercooler requires more water than the cylinders, a tee, inserted at the low-pressure cylinder inlet, leads to a discharge valve for excess water. For parallel piping connections, regulate flow to cylinders so that discharge water temperature does not go below 100 F. Supply maximum quantity of water to the intercooler; sufficient water should flow through aftercooler to lower air temperature as much as possible. Some aftercoolers cool air to within 2 F of cooling-water temperature.

Don't allow water circulation through cylinder jackets and intercooler during shutdowns because condensation destroys cylinder oil film. (POWER covered moisture in air in January 1943, "Why Allow Water in Compressed Air?"; and in April 1942, "'99 44/100%' Dry Air for Circuit Breakers.")

Clean Air Reduces Wear

Clean intake air reduces wear on cylinder walls and piston, reduces dirt deposit on valves and makes a better product for process work. Cool air takes less power to compress than warm. Excess moisture must be separated after compression. As these conditions all affect operation, select the air source carefully. Locate the intake outdoors, at least ten feet above ground level in a cool place away from steam exhaust lines. Intakes on a roof, heated by the sun, take in air that may be five to ten degrees hotter than air at the side of a building. Protect the intake against rain and snow by hooding it, and against dust by attaching a good filter of adequate capacity. Intake ducts of metal pipe, vitrified tile or concrete serve equally well. The pipe must be at least the same size as the compressor inlet (normally 25% of low-pressure piston area); pipe diameter should increase one inch for every 10 ft of length. Increase pipe size proportionately for every compressor added.

Long-radius bends give better airflow than sharp elbows and therefore less pressure drop. Don't run intake pipes side by side or in the same trench with steam lines. Swab out an underground intake occasionally to check against surface water leakage or condensation.

Corrosive Gas

Excessive moisture and corrosive gases in the air cause valve trouble that is generally localized in the second stage of a 2-stage compressor. The air, after passing through the first stage and then being cooled, becomes saturated with water vapor. Corrosive gas absorbed by this water has increased corrosive action. Consult the manufacturer about protection for unusual conditions.

Excessive dirt or grit in the air causes valve trouble and, with lubricating oil, forms a grinding compound that rapidly wears cylinder liners, pistons and piston rings. Some of this dirt and grit is carried in the air and causes rapid wear of pneumatic tools. For full protection, keep air filter equipment clean and in place.

These three examples show the value of air filters: Cleaning the valves, on a 5000-cfm compressor in a railroad shop, was reduced from every two weeks with air intake unprotected, to every six months with filter installed. The engineer of a large compressor plant saved $2200, a 79% reduction in repair costs, by installing filters. Another maintenance saving on two small compressors equaled 62% of the filter's cost the first year.

Careful supervision during operation keeps the machines in service for years without needing major repairs. Numerous tests and practical methods of making repairs will follow.

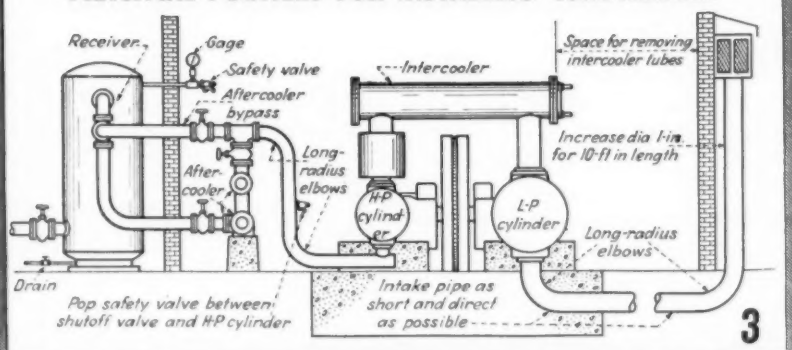
COOLING WATER REQUIRED

Gal per hundred cu ft of free air

Cooling-water temperature	60F	70F	80F	90F
Aftercooler or intercooler separate (80-100 psi, 2 stage)	1.0	1.2	1.4	1.6
Intercooler and jackets in series (80-100 psi, 2 stage)	1.4	1.6	1.9	1.6
Aftercooler (80-100 psi, single stage)	1.0	1.2	1.4	1.6
Both high- and low-pressure jackets with water supply separate from intercooler (80-100 psi, 2 stage)	0.85	1.0	1.2	1.4
Jacket for single stage				
40 psi	0.5	0.6	0.7	0.9
60 psi	0.6	0.7	0.8	1.0
80 psi	0.7	0.8	0.9	1.1
100 psi	0.8	0.9	1.0	1.2

Compressed Air Institute

PRACTICAL POINTERS FOR INSTALLING COMPRESSORS



MAINTENANCE

NEW COMPRESSORS have a known full-load capacity in cubic feet of free air per minute. Ordinary wear of internal parts all add up to one thing: gradual reduction in capacity.

Although finding compressor output based on acceptance-test standards involves a complicated setup, several practical tests disclose any considerable capacity loss. These methods give only comparative results, but comparing one day's tests to previous results gives a true picture of performance.

Beginning with a new compressor or one in perfect condition, measure and record intake pressure, preferably compared with several other compressors. Connect a vacuum gage in the intake line and close intake shut-off valve tightly. Operate machine with free discharge; record vacuum-gage reading for future check tests. Intake pressure under closed suction varies with compressor's internal condition, and indicates: (1) on a reciprocating compressor, condition of both intake and discharge valves as well as piston rings; (2) on a rotary compressor, increase of slippage or leakage past the vanes.

Constant Volume

Knowing that a positive-displacement compressor handles an approximately constant volume of air regardless of the discharge pressure, checking the time taken to fill the receiver to a given pressure is a simple matter. When air to the distribution system can be turned off, a correctly designed orifice properly connected to the receiver also checks compressor output. Using an orifice with constant and known discharge at a given pressure, any appreciable change in compressor output appears as a variation in receiver pressure. For dependable results orifice must be accurately designed, carefully made and tested for discharge capacity. Determine reciprocating compressor performance from cylinder indicator diagrams (For faulty diagrams, see Data Sheet No. 86, POWER, Sept 1939, pg 126). In order to cover methods peculiar to each compressor, maintenance pointers following apply specifically to rotary, centrifugal or reciprocating compressors. First here are tips on coolers and filters.

Amount of heat removed from air as it passes through a cooler depends on cleanliness of cooling surfaces. A solution of hot water and washing soda, in a solid stream or coarse spray, removes oil film adhering to tubes. Flushing water side with alternate shots of water and compressed air stirs up silt and flushes it out the discharge. Keep discharge open, don't build up air pressure on water side. Remove heavy sludge by hosing with a strong stream of water or by shooting cleaning plugs through the tubes; that is, inserting elastic plugs in one end and forcing them through with compressed air. Never apply more than 50-psi air to water side.

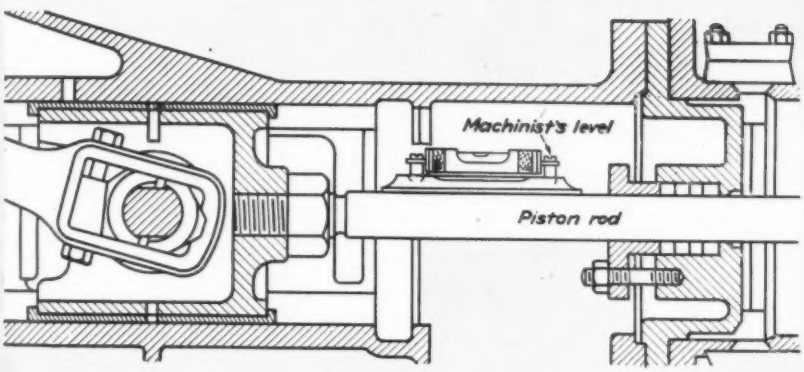
When shooting tubes, keep the far head in place with bolts whose length permits a 1-in. opening between cooler and head. The head stops the cleaning plugs, and air escapes at the free opening. As heads must be removed during cleaning, give head gaskets attention. When partitions cast integral with the heads divide water flow into passes, gasket extensions pass between these partitions and the tube sheet. Replace heads with great care and locate this gasket properly.

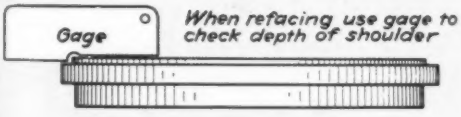
Clean intake filters often enough to remove dirt before the intake is restricted. Cleaning method depends on the filter: dust the dry felt units by blowing air through them in a reverse direction or by washing; wash viscous filters—never use a volatile solvent—and recoat with the viscous fluid; drain and filter the oil from oil-filled cleaners to remove sediment, then scrape and wipe off accumulations adhering to internal surfaces. Certain dry filters and strainers cannot be cleaned; they must be replaced with new ones.

Reciprocating Compressors

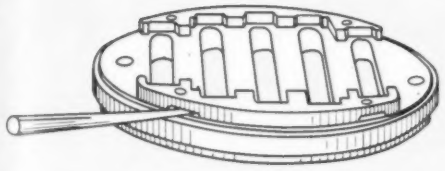
Because of its many moving parts, a reciprocating compressor deserves close attention to keep it adjusted and run-

CHECK THESE ADJUSTMENTS DURING INSPECTION

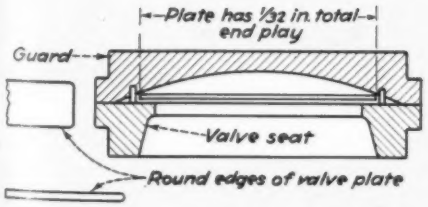




(1) Place a level on piston rod; adjust lower crosshead shoe to level rod. Upper shoe should have .010-in. clearance at running temperature



(2) Keep valve lift the same when machining seat face. This means facing off the guard-bearing shoulder on some valves. Valve plates must be free to move without binding. Round off the edges and corners



ning smoothly. This does not mean extensive repair work but rather hourly observation during operation. Leaking valves, loose bearings or other troubles demand immediate repair.

Leaking discharge valves can be detected by their high temperature during operation or by opening the cylinder indicator-connection valves when the compressor is at rest. An indication of leaking inlet valves is their higher operating temperature when applying the closed-intake test already mentioned.

Remove all valves for cleaning and inspection once a month: Remove all deposits. Check seat leakage by clamping the valve case in a portable test chamber capable of withstanding normal operating air pressure from a hose connection. This method permits checking each individual valve plate after cleaning and assures return to its position in the valve assembly. Wear between valve plate and seat appears as indentations in seat and shoulders on the plate. Eventually this wear causes the valves to leak and surfaces must then be refaced. One alternative to refacing is to turn the valve plate over.

Don't Grind Plates Too Thin

Some valve plates can be resurfaced on a flat grinder but, when grinding, don't reduce the thickness below that allowed by the manufacturer. Ground too thin, a plate may break and fall into the cylinder. Shoulders on the valve seat can be machined off in a lathe; then lap the seat to a smooth finish.

Keep valve lift normal by machining away metal on the guard-bearing shoulder or on spacing washers. Always measure valve lift before doing any machining operation and follow manufacturers instructions. Some valve guards bear directly on the seat surface, automatically taking up for machining.

To check piston ring leakage, turn compressor by hand until piston reaches front end. Then remove front cylinder head and apply air pressure behind piston through a hose connected to rear cylinder-indicator valve. (If cylinder heads remain tight after removing all visible bolts, remove inlet and discharge valves and look for additional bolts inside the head.) Excessive leakage past the piston shows the need of new rings.

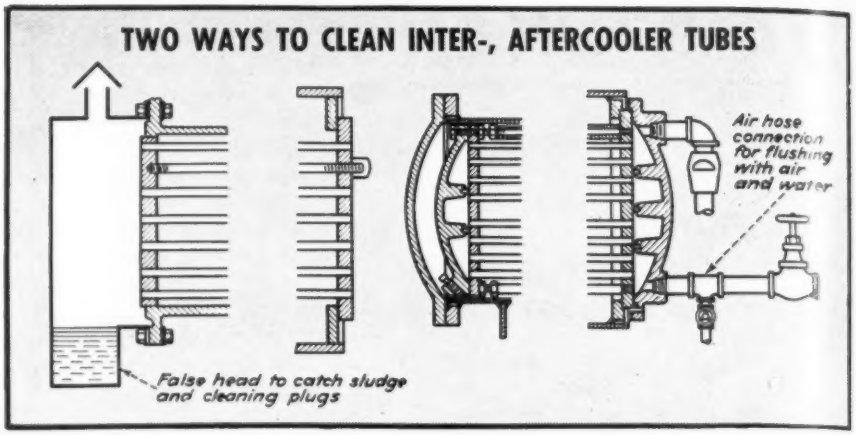
Amount of out-of-roundness of the cylinder barrel determines whether to install new rings without reboring cylinder. Most compressor cylinders permit reboring $\frac{1}{8}$ in. on the diameter; consult the manfacturer for anything above this. Other compressor cylinders contain a renewable wear-resisting liner.

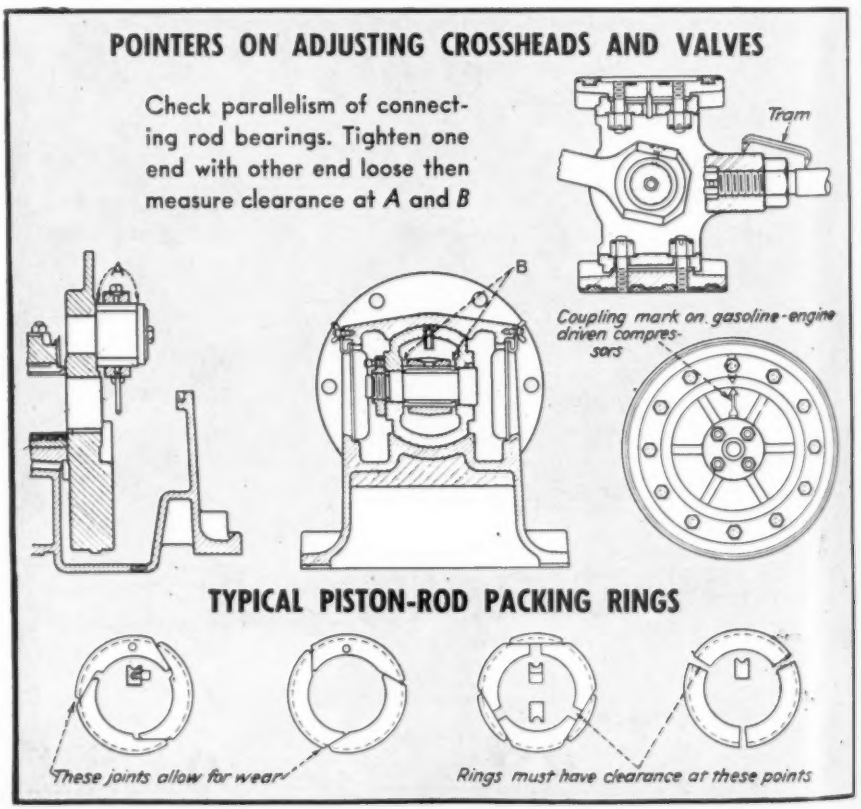
When fitting new rings, push rings into cylinder until they back squarely against piston face. Then measure the ring joint clearance; file ends until clearance equals .003 per inch of cylinder diameter. Rings expand under operating temperature and insufficient clearance causes breakage. After fitting new rings to cylinder bore, prepare to remove piston:

Check tram marks between piston rod and crosshead before loosening crosshead nut. (In addition to the locknut, some piston-rod ends are slotted to fit a lockpin.) Unscrew piston rod from crosshead; use spanner wrench on piston, milled flats on piston rod or rod locknut for turning. Don't attach a pipe wrench to round surfaces of piston rod. After screwing it from crosshead, turn off locknut and remove all packing from the gland. Metallic and carbon ring packing, usually removed by sliding over end of rod, must be protected by a sleeve when passing over the threaded portion of the piston rod.

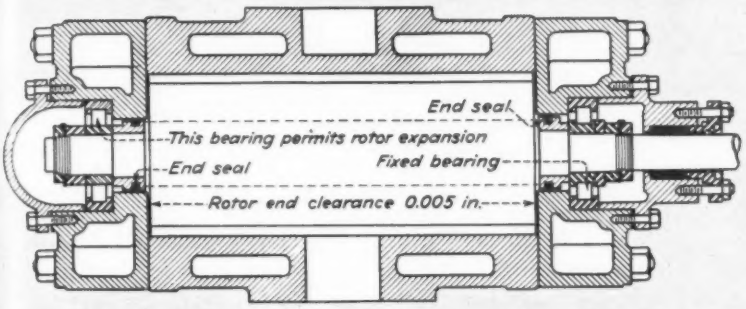
When putting on new rings, keep piston in the cylinder for easiest manipulation, with only ring groove section protruding. Slide new snap rings to their respective grooves by bridging the piston at several points with thin metal strips long enough to bridge foremost grooves. Scrape carbon accumulation from grooves. Clearance between ring and its groove should just allow ring to fall into place of its own weight. Constrict the rings with several turns of tightly drawn rope or by a clamping band until they enter cylinder easily.

Check piston-rod packing before replacing it: Discard old fibrous material;


TWO WAYS TO CLEAN INTER-, AFTERCOOLER TUBES
Air hose connection for flushing with air and water
False head to catch sludge and cleaning plugs


POINTERS ON ADJUSTING CROSSHEADS AND VALVES
Check parallelism of connecting rod bearings. Tighten one end with other end loose then measure clearance at A and B
Tram
A
B
Coupling mark on gasoline-engine driven compressors
TYPICAL PISTON-ROD PACKING RINGS
These joints allow for wear
Rings must have clearance at these points

WORKING PARTS OF ONE SLIDING-VANE COMPRESSOR

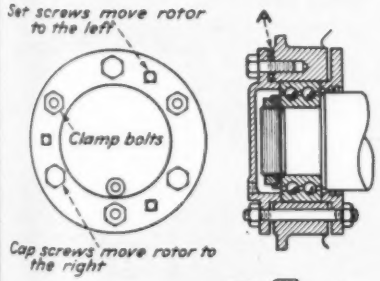


completely separate metallic and carbon ring sections to measure end clearance. Handle packing with extreme care as it is useless if ground splits, faces, ball joints or seats are scored. Babbitt packing rings are especially vulnerable to damage at the thin areas coming in contact with rod or casing. Marks on individual rings show their position.

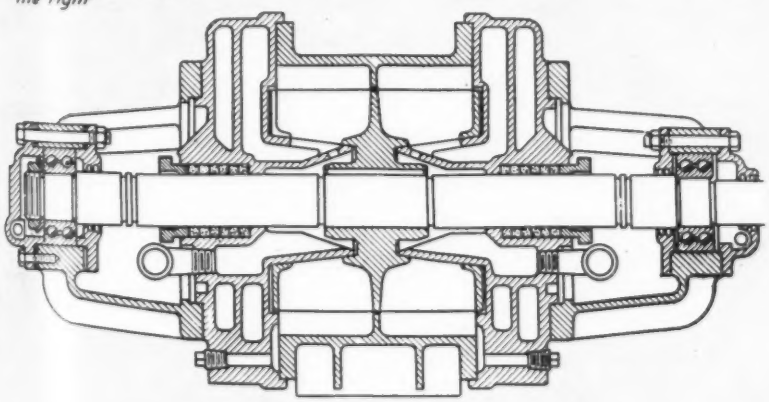
Segmental rings require adjustment when worn. This means that radial segment joints must have clearance when packing encircles the rod. Tangential ring joints need no filing because joint shape automatically adjusts for wear. For abnormal conditions, reseat the packing to the piston rod by scraping the packing. Don't use a file or round off the bore edges of packing rings.

Screw piston rod into crosshead until tram marks show that original position has been reached; then tighten the locknut. Replacing cylinder head completes the job. If old head gasket shows damage, install a new one. Measure thickness of old gasket; if there is any doubt of the original thickness, use material $\frac{1}{16}$ in. thick, cutting all necessary ports in the gasket to fit openings in cylinder and head. After bolting the head securely in place, remove a valve case from each end of cylinder to check piston clearance. Insert a lead wire through each valve opening and turn compressor by hand through one complete revolution. Remove wires and measure their flattened thickness; adjust for any inequality by screwing piston rod in or out of crosshead. Clearance at both ends should be equal at normal operating temperature. Allow for rod expansion if unit is cold.

CENTERING ROTOR OF LIQUID PISTON COMPRESSOR



Measure total rotor end travel at *A*. If it exceeds normal, remove a main body gasket shim. Total allowable end travel varies from .010 to .090 in. depending on compressor size. Then insert shims at *A* to hold rotor in the center



Centrifugal Compressors

Centrifugal compressors, being high-speed machines, vibrate badly once the rotor becomes unbalanced. Vibration at full speed comes from: contact between rotor and labyrinth seals, misalignment, enlarged bearings, or rotor unbalance. Rotor balance can be destroyed by mishandling, deposits of foreign material (tarry substances or uneven painting), and corrosion or erosion of the individual impellers.

Shaft level and alignment sometimes change because of bearing wear; this, as well as end play, must be corrected immediately to prevent serious damage. Thrust bearing restrains unbalanced end thrust, keeping the rotor centered so that excessive end play does not damage labyrinth seals.

Reverse rotation, while not injurious to certain types of thrust bearings, can cause damage from lack of lubrication if the main oil pump operates in only one direction. Normal direction of rotation marked on the casing serves to check the revolving shaft before bringing the machine to full speed. Auxiliary oil pumps, sometimes used during the starting and stopping interval, should be controlled by oil pressure from the main pump so that they start immediately on failure of the main oil supply.

When inspecting the main unit, drain the oil from bearings and pumps, and clean reservoirs, strainers and bearings. When removing upper half of casing, always use long guide studs to prevent damage to impellers and seals.

Take the rotor out and scrape or dissolve all caked dust or other deposits on the impeller and wipe the casing. When cleaning the impeller, inspect it closely for eroded or corroded areas and small individual deposits of foreign matter. A small deposit causes air swirls and eddies, which in turn precipitate additional material on the deposit.

If any sections of the labyrinth packing have rubbed shaft or impellers, scrape them to give proper running clearance. Before scraping, consult the manufacturer's instructions, as some seals using cast-iron rings in babbitt recesses require a running fit. To reduce air slippage, replace seals showing serious wear and excessive clearance. Seals with twice the initial clearance do not produce a noticeable reduction in compressor output.

Rotary Compressors

The ASME test code classifies rotary compressors as: *liquid-piston*, *2-impeller* and *sliding-vane* machines.

The liquid-piston compressor consists of a round multi-blade rotor, revolving in an elliptical casing partly filled with liquid. The operating principle requires close running clearance between rotor and inner mating cones.

A certain amount of wear, caused by water erosion and foreign matter entering with the air, increases rotor clearance and must be compensated for by adjusting at the outer end bearing and at cone flanges. Wear takes place slowly, making frequent internal inspections unnecessary. Before dismantling, mark each part accurately to insure correct reassembling.

In fitting a new cone, set the head up on blocks to allow the cone to slip into place. Remove the cone-holding studs from the head and apply a thin, even film of fine grinding compound where the conical surfaces meet. Set the cone in place and make two revolutions in each direction. Apply no downward pressure as it is only necessary to polish the surfaces to make them tight.

Draw Cone Up Even

After fitting, relieve the outside edge of the head's conical bore by scraping. Center the cone in its proper position to assemble it in the head. If all parts have been marked as previously outlined, no difficulty should be experienced. Tighten the cone nuts evenly, using a dial indicator to check squareness with the head's gasket face.

End travel of the rotor is determined by thickness gage after both ball bearings are installed and the idle-end bearing caps are assembled without shims. End caps are held together by through bolts that move freely in the clearance holes drilled through the bearing bracket. Therefore, moving the end caps longitudinally moves both rotor and shaft for accurate positioning.

The 2 impeller unit, operating without internal lubrication, has small running clearance between lobes and case but makes no rubbing contact at these points. A gib key in one driving gear serves as a takeup adjustment for gear-tooth wear, maintaining even lobe spacing to prevent pounding as the lobes revolve. Internal wear occurs at the lobe ends and casing heads only if excessive end-thrust or out-of-level conditions exist. Maintain end clearance similar to that in sliding-vane machines.

The sliding-vane compressor consists of a slotted rotor fitted with blades and revolving inside a cylinder. Close clearance between rotor and end caps, together with an oil film, serves as a seal against leakage. Machines in which the rotor floats freely between end caps permits actual rubbing between rotor ends and casing. Normal wear occurs mostly on the end caps and worn shoulders must be machined off to bring the clearance back to normal.

Several other designs use a bearing arrangement which holds the rotor centered in the casing to prevent end wear.

Sliding contact between the blades and cylinder wears the blade edges or shoes. Seemingly this wear would be considerable but actually blade wear in one compressor was only .004 in. after 13,000 hours of regular operation.

Permits Considerable Wear

Consult the manufacturer on wear. Depending on compressor design, some blades permit ⅛-in. wear, others ¼-in., or greater. Reasonable wear does not cause leakage. Inspect and replace blades to prevent shortening. Otherwise, they cock and bind in their slots, then bend or break.

Some sliding-vane compressors use rings encircling the rotor to prevent contact between blades and cylinder. Centrifugal action forcing the blades against the rings may cause indentations in the blade edge.

Low-speed machines, having spacer rods to hold opposite blades against the cylinder, use special wearing shoes on the blades. When wear increases the total clearance .002 or .003 in., new shoes or longer spacer rods must be installed to reduce this clearance.

Since sliding-vane compressors can compress to fairly high pressures, leakage past the rotor and at shaft seals can be a major item. An over-thick gasket between case and end cap permits serious air slippage. When installing new gaskets measure the old ones and make allowance for compression of the material. Easy removal of casing end caps facilitates internal inspection of rotor and blades.

Removing one end cap exposes the rotor and permits checking the blade movement. If a blade binds in its slot, this binding can be relieved by filing or cleaning the blade sides with emery cloth. Clean the blades thoroughly before replacing.

ACKNOWLEDGMENTS

For assistance in preparation of this section, POWER is indebted to Allis-Chalmers Mfg Co; Allen Billmyre Corp; American Blower Corp; American Air Filter Co Inc; American Brake Shoe & Foundry; Air-Maze Corp; Andale Co; Bailey Meter Co; Beach-Russ Co; Bury Compressor Co; Burgess Battery Co; Chicago Pneumatic Tool Co; Clark Bros Co Inc; Cooper-Bessemer Corp; Crane Co; Compressed Air Institute; Cleveland Rock Drill Co; R Conrader Co; Cochrane Corp; C Lee Cook Mfg Co; Coppus Engineering Corp; Chaplin-Fulton Mfg Co; De Laval Steam Turbine Co; Elliott Co; Fuller Co; Foster Pump Works Inc; Fisher Governor Co; Gardner-Denver Co; Hagan Corp; Ingersoll-Rand Co; Johnson Corp; Leavitt Machine Co; Maxim Silencer Co; Nash Engineering Co; National Carbon Co Inc; Nordberg Mfg Co; Norwalk Co Inc; W H Nicholson & Co; Oakite Products Inc; Owens-Corning Fiberglas Corp; Pennsylvania Pump & Compressor Co; Roots-Connersville Blower Corp; Schramm Inc; Sullivan Machinery Co; B F Sturtevant Co; Staynew Filter Corp; Swartwout Co; A Schrader's Sons; J H H Voss Co; Worthington Pump & Machinery Co; Wright Mfg Div; Yeomans Bros; Yarnall-Waring Co

Practical suggestions for creating emergency capacity . . . substitutes for hard-to-get parts and materials . . . cures for overloads, breakdowns . . . ways to build up short-handed staffs. Share your ideas! Send in your rough notes and photos or sketches. Payment at regular rates

WARTIME POWER CLINIC

VALVE REPAIR SPEEDS WAR EFFORT

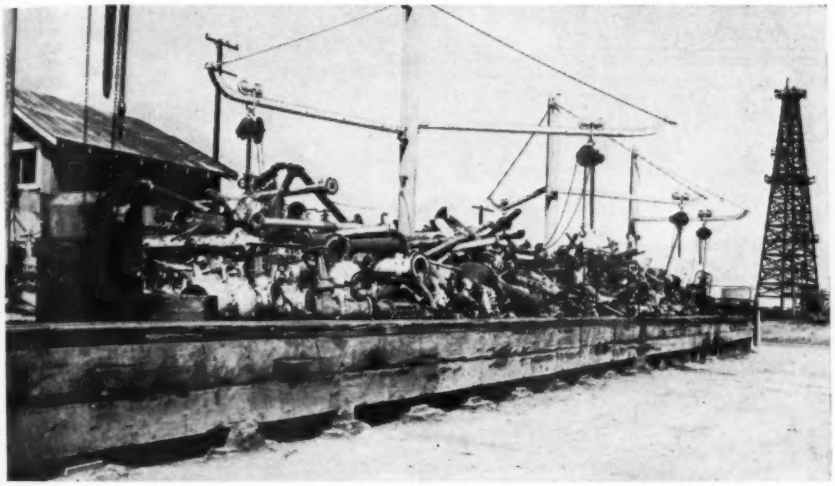


Fig. 1—Trucks bring salvage to several classification "docks" like this for temporary storage before inspection and segregation. Unusable parts go to melting scrap. Repairable valves are broken out of connections for reprocessing

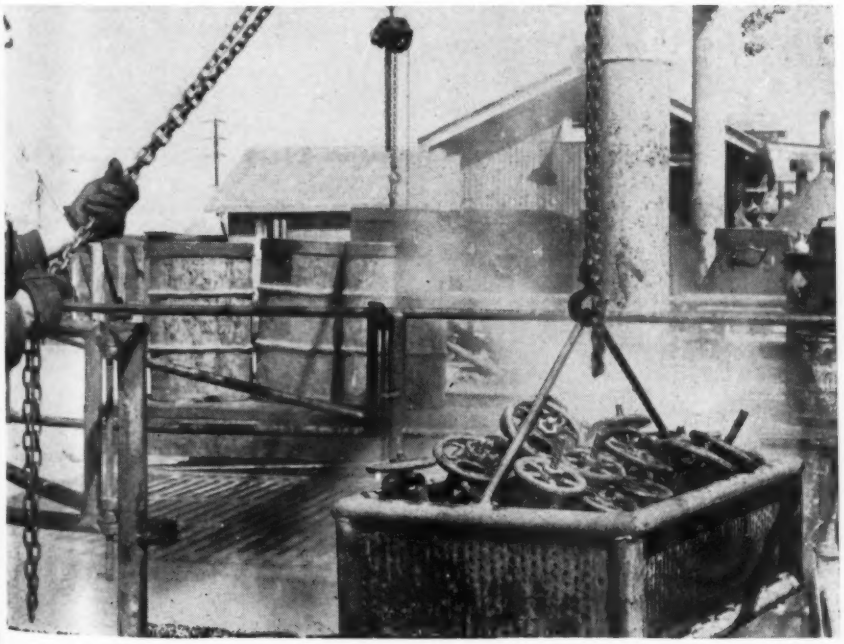


Fig. 2—Before reconditioning, valves are stacked in metal baskets and degreased in vat of hot cleaning solution

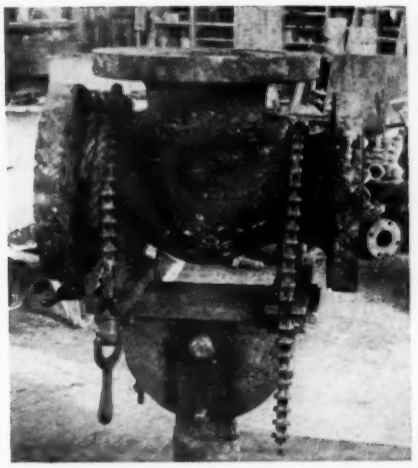


Fig. 3—Combination chain vise and tilting head reduces the labor of valve inspection and reconditioning

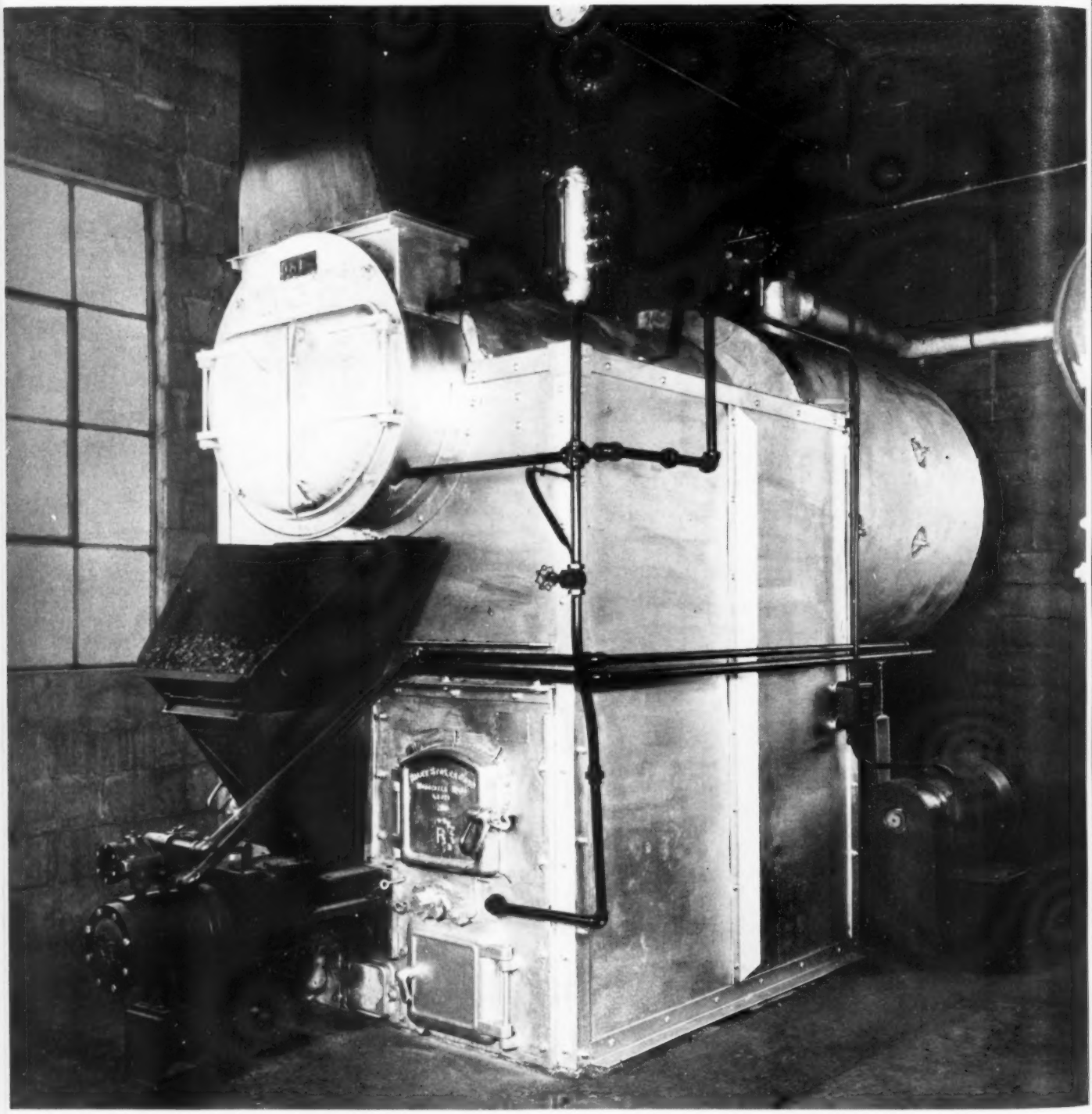
▶To BUILD UP a reservoir of replacement valves, while speeding the national scrap drive, a major oil company operates a salvage department through which all discarded fittings must pass. The company reconditions all valves that they can put back into service, and sets the rest apart as commercial furnace scrap.

When America's need for melting scrap first became evident, this company started collecting all idle equipment available anywhere within the organization. Unloaded from huge transport trucks onto convenient "docks", Fig. 1, the entire collection moves through an inspection line where power machines break out some parts and hand tools break out the remainder. The various parts then go in designated directions according to type and alloy.

Some of the heavier pieces move into scrap piles of heavy melting steel, while the lighter pieces form stacks of "bushelings." All flanged and bolted fittings are segregated from the common run of scrap until an inspection determines their worth.

(CONTINUED ON PAGE 102)

When you convert from oil to coal



RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Baltimore Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis Richmond

It will pay you to visit modern Riley Installations

install Riley-Jones Side-Dump Stokers

they will prove a profitable investment

If the oil conservation program requires that you change from oil to coal firing, we believe it is only sound business to install equipment which will give the best performance and which will prove a profitable investment. If you install Riley-Jones Stokers, you will find, due to savings in fuel costs, that you have made a profitable investment and will be assured of continuous satisfactory performance by the rugged efficient design and construction of this stoker.

This has invariably been the experience of the hundreds of plants where Riley-Jones Stokers were selected when changing from oil to coal. Here are two specific examples.

The Winston-Churchill Apartments at St. Louis advise:

"It formerly cost us about $4000.00 per year to heat and furnish hot water, using oil at 4⅛ cents per gallon. With the Riley-Jones Stoker we can furnish heat and hot water at $1500.00 per year."

The Alcazar at Cleveland, Ohio, writes:

"In our case we were burning oil previous to the installation of the stoker and found that our saving was easily 65% of the fuel cost."

Good performance has been built into Riley-Jones Side Dump Stokers. Their simple rugged construction assures long, continuous service with a minimum of maintenance. The Riley-Jones Stoker has been a leader in the small stoker industry since 1888 when Mr. Jones invented and perfected the first successful underfeed stoker. The Riley-Jones Stoker is the daddy of all underfeed stokers.

A qualified Riley-Jones Stoker engineer will gladly—at no obligation whatsoever to you—call at your plant to discuss your fuel burning problems with you. Riley-Jones Stokers are manufactured in various sizes for installation under boilers from 40 H.P. to 600 H.P.

A few of the thousands of users of Riley-Jones Stokers

General Electric Co.
American Brass Co.
R. C. A. Manufacturing Co.
General Motors Corp.
Henry Disston & Sons
Ford Motor Co.
Sperry Gyroscope Co.
Revere Copper & Brass Co.
American Steel & Wire Co.
Republic Steel Corp.
Royal Typewriter Co.
Remington Rand, Inc.
Coca-Cola Bottling Co.
Bullard Company
Colt's Patent Fire Arms Co.
Pet Milk Co.
Carnation Milk Co.
Fairmont Creamery Co.
Swift & Co.
Dairymen's League
Bakelite Corp.
Moore Steam Turbine Co.
Bell Aircraft Co.
Walworth Co.
Yale University
American Can Co.
Champion Spark Plug Co.
Minute Tapioca Co.
Armstrong Cork Co.
American Bridge Co.
Strathmore Paper Co.
Nunn Brush Shoe Co.
Reynolds Metal Co.
Dow Chemical Co.
Hickey-Freeman Co.
Holeproof Hosiery Co.
Lake Placid Club
Electric Boat Co.
U. S. Gypsum Co.
Van Camp Packing Co.
American Creosoting Co.

A survey of your power plant by a consulting engineer will possibly shows ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

before purchasing Boiler or Fuel Burning Equipment

(CONTINUED FROM PAGE 99)

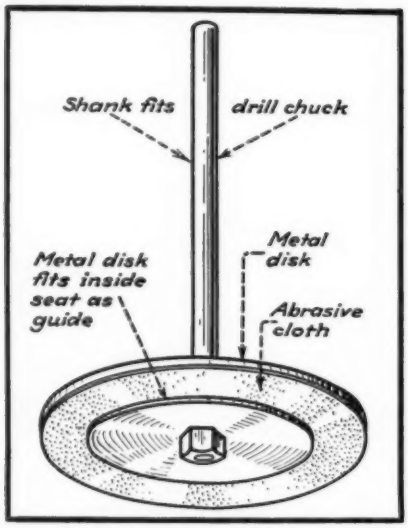


Fig. 4—(left) Mechanic refaces small valve wedge with abrasive cloth mounted on a rotating block. Fig. 5—(above) Large gate valve being reconditioned with abrasive-cloth disk to smooth the wedge seat that is cast integral with body. The special tool shown in the detail sketch serves to resurface the contact parts

When preliminary inspection indicates that the valves and fittings may have immediate use value, they are stacked alongside the shed housing the dismantling machinery until they can be hauled to the cleaning tubs.

Roughly sorted by size and brand, the valves are stacked in sturdy wire baskets, Fig. 2, and lowered by chain hoist into a vat of boiling detergent, where they are left long enough to loosen any incrustation and paint. Then the valves are further rough-cleaned with high-pressure water jet, then dried and finish-cleaned with a power-driven brush, a close inspection determines their exact condition.

Good stud nuts are carefully removed and stored for reuse. Acetylene torches remove corroded nuts and bolts, which are segregated as melting scrap along with other unusable parts. But brass and bronze stems are reused even if broken; two pieces from different fittings are frequently brazed together and machined to make a stem as good as new.

Special spanners unscrew removable valve seats for refacing on a lathe. If wear is excessive, welding or brazing first restores the thickness. Sometimes both wedge seats and wedge are built up and refaced in this manner.

Rebuild Many Valves

When the wedge seat is cast integral with the body, the special tool, shown in the detail sketch of Fig. 5, resurfaces the contact parts.

Smaller tools face the seats and wedges of small, low-pressure brass and bronze valves. When a valve has been so distorted by service strains that the wedge no longer seats properly, a screw press forces the wedge down until it seats. This operation is necessarily followed by the grinding of the wedge and seats.

Metal spray or arc welding builds up lubricated plug valves, which are then machined to correct diameter and taper. If necessary, the inside of the body, also, is machined lightly to accommodate the new plug and remove scores on the working face. In any event, fittings are ground tight after machining.

When the valve has been conditioned and reassembled, it is hydraulically tested at double the expected pressure, and then is date stamped for reference either on the body or on the edge of the flange.

With this company, cost of rebuilding a valve is a secondary consideration. The primary objective of this salvage procedure is the conservation of manpower and material. However, reconditioning cost is only about 20% of present replacement value at supply stores.

Santa Monica, Calif. J C ALBRIGHT

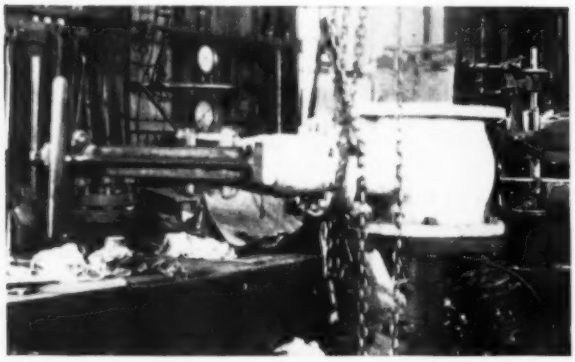


Fig. 6—Hydraulic pressure, at double the expected working pressure, checks condition of the reconditioned valve

Fig. 7—Stack of various types of valves and fittings, reconditioned and repained, ready for a new application

Food—The Deciding Issue

Our food problem remains to be solved

THE first thing the Germans did when they occupied Czecho-Slovakia, Poland, Belgium, France—was to empty all warehouses. Everything went into trucks headed for Germany.

The Nazis knew that this war would be won by the army that had the most supplies and the best supply system.

The Nazis knew that supplies are as essential as guns. They knew that the most essential of all supplies is . . . food.

Being the only people on earth who can watch women and children starve, the Nazis seized upon food as their most powerful instrument for disciplining the masses. They added famine to their arsenal of conquest.

The flocks and herds of Europe are being consumed with alarming rapidity. The desperate shortage of meats and fats is growing steadily worse. Our Allies are short of certain foods that we must supply if we expect them to carry on.

And as we supply them, as our imports are curtailed, as our fighting men consume more than they do in civil life, and as we fail to increase our production rapidly enough . . . we, too, become short of certain foods.

Former President Herbert Hoover, speaking before a conference of the Governors and Representatives of twelve Mid-Western farming states in Des Moines on March 15th, sounded the warning that American agriculture, beset by Washington bungling on manpower, farm machinery and price systems, strangling production and distribution, is facing a deterioration which may bring on a national food shortage such as led to the collapse of Russia, the defeat of Germany in the first World War and the fall of France in the present war. Unless this deterioration is stopped, warns Mr. Hoover, we cannot hope to win the present conflict.

Complications of similar magnitude face the food processor and the distributor.

Never in the history of the world has man's dependence on food been so crucial. Yet it is not easy for us to grasp the full significance of the crisis. We are so accustomed to finding milk, eggs and butter on our doorsteps every morning, we are so used to filling our pantries from the shelves of our grocers and markets that we accept food as something that is due us on demand. We do not stop to think that we never are more than a few meals ahead of famine.

But this picture has changed. Now we are faced with food rationing, and every day the shelves of our food markets become more bare.

* * *

Let it be noted that the appointment of two Food Administrators has not solved the food problem. It is still with us; daily it becomes more critical. Unless it is solved, and solved quickly, the very food that ex-Food Administrator Wickard said would "win the war and write the peace" may lose the war and lose the peace.

Put very simply and clearly, the food problem amounts to this: we are trying to feed upward of 200 million people. We are trying to do it with the farms and other facilities that heretofore have been capable of feeding about 145 million people (our present population plus a 5% surplus).

Had the Government foreseen the need and planned ahead, we could have begun by 1941 the enlargement of our farm production and food processing capacity. Two irreplaceable years have been lost!

The gravity of the situation becomes apparent when we consider that 50,000 factories are required to process our foods. Food processing not only is America's biggest industry—it is one of America's most important for, without processing, most foods would perish before they could reach the consumer. The term "processing" covers the salting, drying, smoking, pickling, chilling, canning, packing and other methods of preservation that make it possible for us to eat in 1943 food that was produced in 1942. Few realize that most of the food we shall eat in 1943 was produced and processed last year, that most of the seed we plant this spring will grow food for 1944 or perhaps later.

In one important process of preservation, tin and rubber are vital materials. When the Japs captured Malaya and the Netherlands East Indies more than half of the world's tin and nearly all of its rubber fell into their hands. This forced drastic changes upon our entire food economy. The importance of tinplated steel containers, tops for glass jars and rubber gaskets is fairly obvious . . . metal food containers alone consume, every year, more than 2,700,000 tons of steel.

The aggression of Japan has snared our whole food industry in a maze of intricate packing problems. It has enforced recognition of a new principle of food technology, i.e., that the *method* of food preservation is determined by the *type* of container available. The tin, steel and rubber stringency compels many food processors to adopt

unfamiliar methods — methods that call for a great deal of new equipment. This, in turn, involves the use of critical materials that are so urgently needed for other war purposes.

This conversion of the food processing industry to meet these exacting restrictions has been greatly complicated by two factors that have increased its wartime burden. Indeed, it is these that provide the principal reason for civilian food rationing.

The first of these is the task of feeding our armed forces overseas. Allied ships are being sunk at an alarming rate and the loss of cargo is considerable.

The second factor gravely augments the first. Under Lend-Lease our country is undertaking to feed our Allies to the extent of approximately 60 million people.

Types of food required for Lend-Lease and the armed forces are the finest we can produce. They are the high protein foods, especially meats, cheese and milk; and the protective foods which rate high in vitamin content. Peculiarly enough, the more valuable a food is from a nutritive angle, the more specialized is the processing required to preserve it.

The food processing industry, handicapped as it is, is meeting today's challenge with resourcefulness and enthusiasm . . . despite container complications and shipping shortages.

This is the tenth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers, and in daily newspapers in New York, Chicago and Washington, D. C. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.

It is accomplishing its Herculean task by resurrecting and modernizing a method of food preservation that is as old as mankind. Probably you have read a great deal about dehydration. You actually may have eaten dehydrated food, but right now nearly every bit of dehydrated food is earmarked for the armed forces or for Lend-Lease.

Food processing never will be as spectacular as the production of bombers or tanks. But under today's conditions, the performance of the food processor is no less important . . . no less inspiring. When we consider that dehydrated food is compressed into solid blocks with a density nearly equal to that of coal, so that almost a whole meal can be carried in a vest pocket, and that half of the shipping space is thereby saved in transportation, we begin to appreciate what the processors have contributed to meet the food problem imposed by the war.

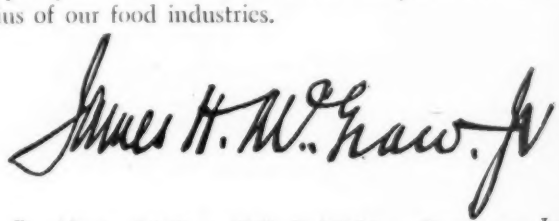
But they have not only contributed new methods, they are achieving new highs in production. And now they are asked to do what borders on the impossible. Consider dehydrated egg powder. Normal production in pre-war years was about 3,000,000 lbs. In 1940 this was increased two and one-half times, in 1942 it was stepped up again, this time forty-fold. And in 1943 the call is for another 60 per cent boost, to make a total of 480,000,000 lbs. Dried milk powder production of 350,000,000 lbs. in 1940 must be increased to 685,000,000 lbs. in 1943.

Vegetables, which were a small item to the processor before the war, now are dehydrated in enormous quantities. The vegetable dehydration industry has had to grow by leaps and bounds without benefit of the high priorities accorded to arms, ship and aircraft building. Production of dehydrated vegetables in 1942 was four times that of 1941, and 1943 calls for a sixteen-fold increase over 1942.

Total dehydrated food production in 1943 is scheduled at 1,750,000,000 lbs., dry basis . . . *all for export*. Multiply that by 10 and you have a rough approximation of the astronomical amount of raw materials that will have to be produced.

Many problems remain to be solved in the troublesome days that lie ahead. But with all his resourcefulness, man has little control over the weather. A severe drought could wipe out all of man's carefully laid plans. If we are tempted to reassure ourselves with the thought that the food situation probably is not so serious as it is painted, it will be well to remember that last year's crop increase over 1941 was due to better than average growing weather.

The war-bred food crisis that now confronts us will be met only by immediate measures to insure a food production ample to allow for adverse weather conditions. The food processing industry is capable, but has not been granted the needed help, in coping with its tasks. The food problem as a whole involves all three functions of production, processing and distribution. And if we are to master the problems that now beset us, all three of them must be coordinated under a single administrative control. "Food will win the war and write the peace". But if American food is to do that double job, we must develop a capacity for food *administration* comparable with the genius of our food industries.



President, McGraw-Hill Publishing Company, Inc.

Going, Going, Gone—to War!

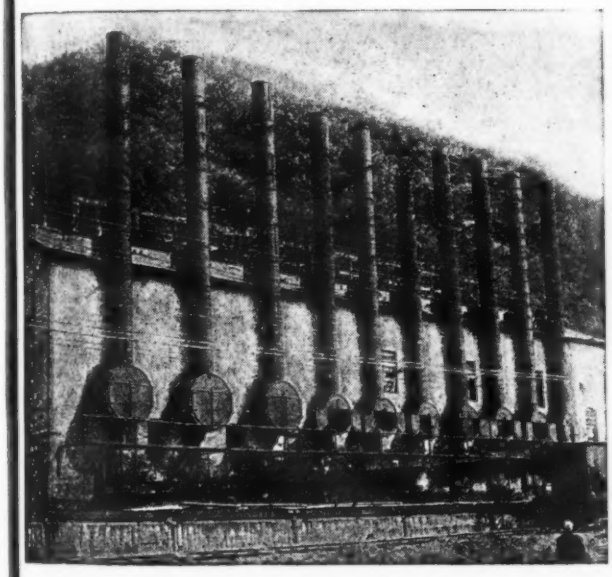
▸POWER ENGINEERS EVERYWHERE, in big plants and small, have a job to do, a job that requires the same kind of ingenuity and persistence that keeps power units on the line day in and day out. What's the job? Getting in the scrap needed to keep the steel mills turning out headaches for Hitler.

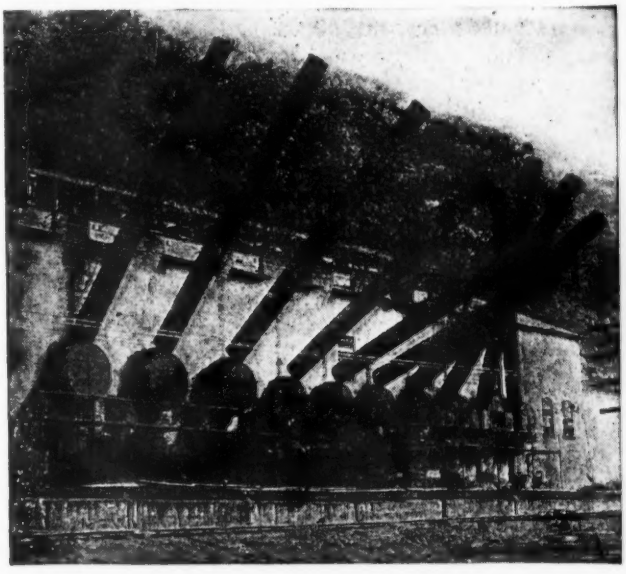
By now, this scrap job has passed the point where "collection" is the answer. Just rounding up odds and ends of scrap metal isn't enough. Somebody's got to get tough enough to say "scrap it" for all equipment that can't be put to war work in three months.

In most plants, this tough "somebody" has to be an executive, and a top executive at that. He's got to be able to make decisions that will stick. Most companies now have such a "scrap chief", others will have one soon. In either case, don't wait to be asked; scour the power plant and all parts of the plant under your jurisdiction and make your own list of materials and equipment that can be drafted into the scrap army. Taking the initiative this way not only proves you're on the job but it starts the scrap rolling toward the mills just that much faster.

Successful scrap-hunting depends on overlooking nothing, particularly the stuff that's so big you can't see it. It's easier to walk past an unused tank without seeing it as scrap than it is to miss a cracked casting in a dark corner. Somehow it seems to take more courage to condemn the big stuff but remember that an obsolete boiler is just as useless to you as damaged valve, and worth many times as much to Uncle Sam. Remember also that the undepreciated value of equipment turned over to salvage may be deducted from Federal income tax for the current year.

The pictures below show one part of the scrap job done by Glen Alden Coal Co—four stages in the progress of ten steel stacks from idleness to a wartime job as scrap. It took eight men all day to dismantle this obsolete equipment, but the scrap paid dividends to the plant, to the salvage contractor and to the armed forces of the nation.





Diesel Performance Here and Abroad

American and British reports on oil-engine power costs present valuable data on diesel-plant performance and maintenance

▶ IN SPITE OF WARTIME difficulties, the Oil and Gas Power Division, ASME, and the Diesel Engine Users Association, of Great Britain, have managed to continue their valuable work in the publication of diesel-engine operating and cost records. The DEUA's "Report on Heavy-Oil-Engine Working Costs, 1940-41" was published in September and copies have recently become available in this country. The ASME's "Oil-Engine Power Cost Report, 1941" has just been issued. Both contain data that should prove interesting and valuable to all users of diesel engines and to those contemplating installations when such equipment again becomes generally available.

Highlights of Reports

This article presents some of the highlights of these reports and summarizes the general nature of the material in them. Unfortunately, differences in method of presenting data make it difficult to make the direct comparisons between the reports that would be most enlightening to engineers and, of course, differences in exchange rates and in working conditions here and abroad make it impossible to draw any comparative significance from the cost figures.

Both reports publish full data on fuel consumption. Table I and Fig. 1 show the British results and Fig. 3 shows the American figures. In Fig. 1, the results of 42 plants, expressed in lb per kwhr, are plotted against running plant load factor, which is defined as total units generated times 100, divided by rated capacity of engine No. 1 times the hours run by No. 1, plus rated capacity of engine No. 2 times the hours run by No. 2, and so on for each engine in the plant. A general average for all reporting stations is also plotted. For comparison, two "standard" curves are shown: one represents the performance that might be expected from a 220-kw air-injection engine; the other represents performance of a modern solid-injection engine.

Table I reports fuel-consumption figures for the 19 years covered by the

Table I—Average Fuel Consumption

Data from DEUA Report on Heavy-Oil-Engine Working Costs, 1940–41

Year	*Total no. stations*	*No. below std curve*	*Average fuel consumption, all stations, lb per kwhr*	*Avg running-plant load factor, %*	*Fuel consumption related to std curve, % above or below*
1922–23	31	3	0.734	59.4	8% above
1923–24	36	3	0.748	57.7	10% above
1924–25	41	4	0.731	60.8	9% above
1925–26	45	9	0.725	60.1	8% above
1926–27	53	9	0.724	60.3	8% above
1927–28	50	8	0.710	61.8	6% above
1928–29	56	6	0.721	62.5	8% above
1929–30	44	9	0.708	64.3	7% above
1930–31	50	18	0.692	66.0	8% above
1931–32	54	19	0.687	63.5	3.5% above
1932–33	54	29	0.648	67.2	1% below
1933–34	57	29	0.642	67.5	2% below
1934–35	52	28	0.637	68.8	3% below
1935–36	56	38	0.642	65.9	3% below
1936–37	66	40	0.647	67.3	2% below
1937–38	75	44	0.635	62.3	5.5% below
1938–39	58	31	0.634	63.9	4.5% below
1939–40	62	37	0.618	64.0	7% below
1940–41	42	25	0.625	67.0	4.8% below

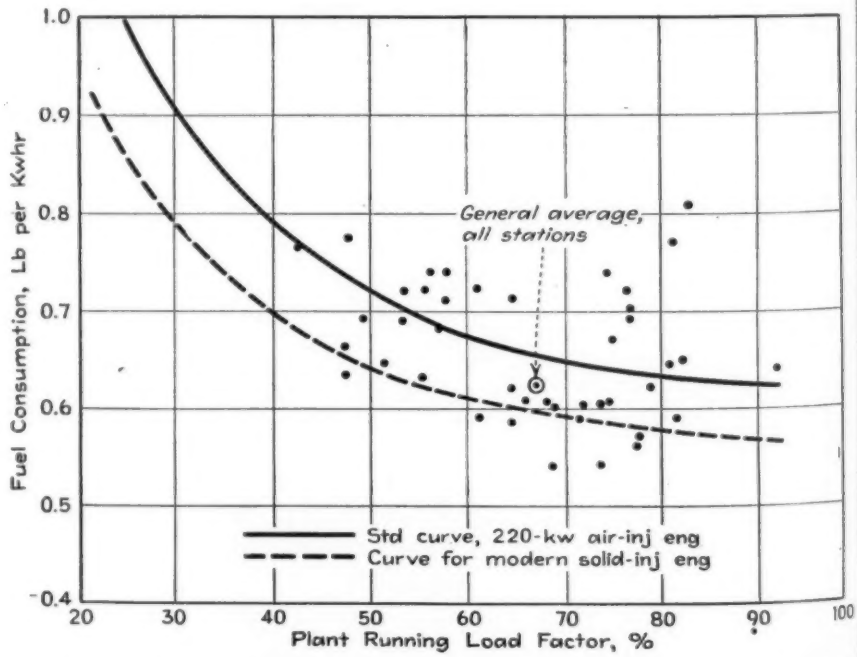
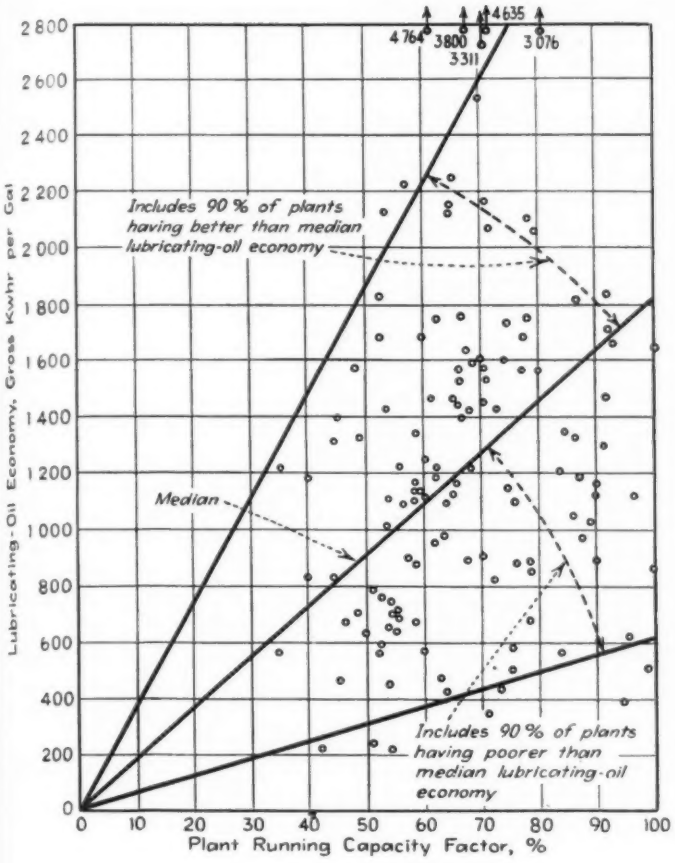


Fig. 1—Data from British report shows fuel consumption for reporting plants plotted against "standard" curves for air- and solid-injection engines



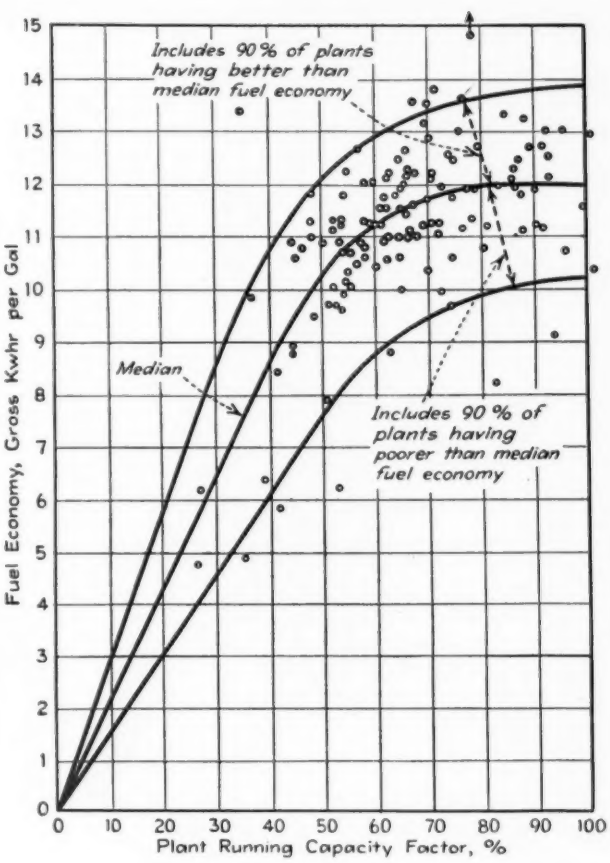

Fuel Economy, Gross Kwhr per Gal
Plant Running Capacity Factor, %
Includes 90% of plants having better than median fuel economy
Median
Includes 90% of plants having poorer than median fuel economy

Fig. 2, 3—American report shows lubricating-oil and fuel consumption for reporting plants, plotted against running plant capacity factor. Median lines added to show trend of data and facilitate interpretation of plotted results

DEUA reports, showing number of stations included, the number of stations falling below the standard curve (air-injection), average fuel consumption, average running plant load factor, and percentage above or below the standard curve. It is interesting to note that the last ten years reflect a definite improvement in performance, only partly accounted for by a slight improvement in load factor. Most of the gain must be credited to the growing percentage of solid-injection engines.

Fuel Economy, U. S. Plants

Fig. 3 shows fuel-consumption for 121 American full diesel plants, expressed in gross kwhr per gal of fuel, plotted against plant running capacity factor, which is defined as plant output in gross kwhr times 100 divided by kw rating times number of hours operated. POWER's editors have added the median lines to indicate the general trend of the data, following the method used in past ASME reports.

In the original ASME report, plotted points on both the fuel-oil curve, Fig. 3, and the lubricating-oil curve, Fig. 2, are coded to indicate the nature of the engines installed in each plant. The plotted points also carry identifying numbers permitting ready reference to the extensive and valuable tabular data.

In respect to lubricating-oil consumption, the methods of reporting again differ. In Fig. 2, data from 120 American full diesel plants, expressed in gross kwhr per gal, is plotted against plant running capacity factor. The me-

Table II—Lubricating-Oil Consumption

Data from DEUA Report on Heavy-Oil-Engine Working Costs, 1940–41

Year	*Total no. stations*	*No. stations with more than 2380 rated bhp-hr per gal*	*Percent stations with more than 2380 rated bhp-hr per gal*	*Average rated bhphr per gal for all stations*
1922–23	31	9	29	1330
1923–24	36	9	25	1390
1924–25	41	9	22	1455
1925–26	45	15	33	1615
1926–27	53	19	36	1470
1927–28	50	16	32	1490
1928–29	56	14	25	1345
1929–30	44	10	23	1385
1930–31	50	12	24	1720
1931–32	54	17	32	2010
1932–33	54	24	44	2385
1933–34	57	21	37	2190
1934–35	52	23	44	2150
1935–36	56	24	43	2185
1936–37	66	31	47	2275
1937–38	75	30	40	1870
1938–39	58	28	48	2030
1939–40	62	25	40	2140
1940–41	42	18	43	2120

dian lines have been added by POWER's editors. The DEUA has set up an arbitrary standard of 2380 rated bhphr per gal for lubricating-oil consumption, and plant performance is measured against this figure. Table II shows British results from 1922-23 to 1940-41, indicating the number of stations above the standard and the average for all reporting stations. The column of percentages has been added to make yearly comparisons easier. Again the last ten years show a definite improvement, probably resulting more from better operation and greater knowledge of lubricating-oil characteristics than from any marked change in engine design. However, more widespread adoption of full pressure lubrication probably accounts for some of the gain.

Engine and Operating Data

Both reports contain a wealth of information on engine details and operation. Particular interest attaches to the three tables which make up the bulk of the ASME report. Table I of this report lists each plant, by identifying number, and shows type of plant and load, number of engines, total capacity, total hours of operation, gross and net output, percent of gross output used in plant, annual plant load factor, running plant capacity factor, average fuel- and lube-oil cost, total fuel- and lube-oil cost, attendance cost, cost of supplies and water, cost of engine repairs and all other plant repairs, combined cost of repairs, supplies and miscellaneous, and total production cost.

Inclusion of data on engines and plant operating statistics makes it possible for the interested engineer to select plants which operate under conditions similar to his plant or to the plant he contemplates installing.

Table II of the ASME report summarizes plant operating statistics and cost data for each plant over the entire period for which information is available. The number of plants on which data for six succeeding years, or more, is available now runs to 91, with 38 plants represented for ten years or more. As time goes on this table becomes more valuable, as data covering a period of years is less likely to be affected by unusual factors and thus to represent more nearly true average performance.

For engine details and operating information, turn to Table III of the ASME report. For each engine in each plant, this compilation lists all significant engine data such as speed, cylinder dimensions, type, etc; detailed figures on lubrication and method of treatment; nature of fuel oil used and amount; data on loading, including bmep; data on piston cooling and air filters; information on type and operation of jacket-cooling system; a breakdown of repair costs into materials and labor for both routine maintenance and repair of engine accidents; figures on number and time of enforced shutdowns; data on shifts, hours per shift, number of attendants per shift and man-hours per net kwhr. It is impossible to stress too strongly the value of the information gathered in this table. Here is the place to check the performance of an operating plant against other similar plants and here is the place to assemble the basic facts required to make a sound estimate of the performance of a proposed plant.

British Maintenance Data

The engineer interested in following the matter further will find more or less similar tables in the DEUA report, and while they represent British practice under conditions that may differ widely from those in this country, much information may be gleaned from study and comparison of the two sets of tables.

This year, the DEUA report includes a new compilation, Table V, which sets forth detailed operating data on ten plants, covering particularly such matters as rate of wear of engine parts and hours run between various maintenance operations. Because this is a new feature, the data is somewhat scanty and is insufficient for drawing any really sound conclusions. However, a rough summary of the highlights is given in Table III of this article, for the benefit of interested engineers. If Table V is continued, the data should prove useful.

How to Obtain Reports

Copies of the ASME "Oil-Engine Power Cost Report, 1941" may be obtained from Publications Sales Dept, American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y. Single copies are priced at $1.00 to ASME members and $1.25 to nonmembers. Copies of the DEUA "Report on Heavy-Oil-Engine Working Costs, 1940-41" may be obtained from the Diesel Engine Users Association, 56 Victoria Street, London, SW1. Single copies cost 10 shillings and sixpence, about $2.75. Only a limited number of copies is available.

Table III—Operating Data on Engine Parts

Data from DEUA Report on Heavy-Oil-Engine Working Costs, 1940–41

Engines reported are mostly slow-speed, vertical, 4-cycle units. Half of the 56 units are air-injection, the remainder being solid injection. Cylinder sizes range from 7.5x12 in. to 20.75x20.75 in., with most engines about 14x16 in. Data includes ten plants: four central stations, four waterworks, and two industrial establishments.

Overhauls:	Time between overhauls varies from 2000 to 21,000 hr; median time is 4000 hr. One plant reports carrying out overhaul operations in sections.
Decarbonizing:	Time between carbon removals varies from 1000 to 5000 hr; median time is 3000 hr.
Valve grinding:	Time between valve grindings varies from 200 to 3000 hr; median time is 500 for exhaust and 900 for air valves.
Cylinder liners:	Shortest life reported is 18,255 hr; longest, to date, is 55,395 hr. Lowest rate of wear is 0.0004 in. and highest is 0.0037 in.; median is about 0.001 in. per 1000 hr.
Pistons:	Shortest life reported is 3876 hr (for head only); longest is 68,738 hr to date. Rate of wear is so low as to be negligible in most cases; highest reported is 0.001 in. per 1000 hr.
Piston rings:	Shortest life reported is 2000 hr; longest is 24,000 hr; median runs about 6700 hr for compression rings.
Main bearings:	No significant data reported.
Big-end bearings:	Shortest interval between re-metalling is 16,000 hr; longest is 68,738 hr, to date.
Wristpins:	Scattered data indicate wear at rate of 0.0001 to 0.0002 per 1000 hr.

THE OPERATING ENGINEER

George Edwards
Advisory Editor

PRACTICAL AIDS • MAINTENANCE HINTS • QUESTIONS—ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Double Furnace Volume Gives Double Boiler Capacity

Oliver Rantanen tells how redesigning and rebuilding furnaces under four boilers doubled furnace volume and boiler output. These changes also eliminated serious refractory troubles and removed a bottleneck in the steaming capacity

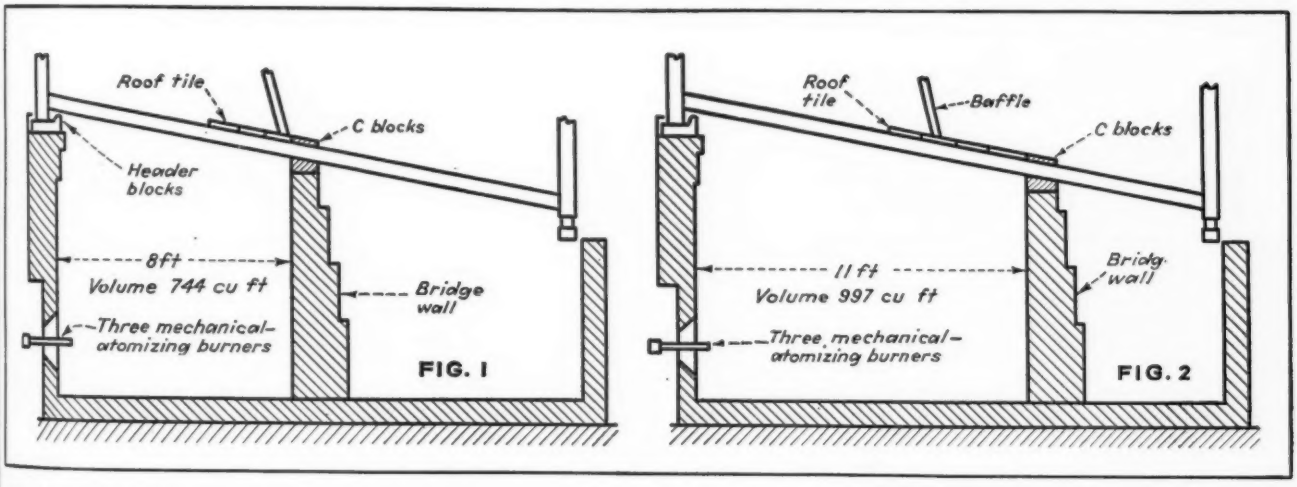


Fig. 1—Original furnace had a volume of 744 cu ft which limited boiler capacity to about 75% of normal

Fig. 2—Moving back the bridgewall increased furnace volume to 997 cu ft and increased boiler capacity

AT ALL TIMES plant engineers should strive to burn fuel as economically as possible. But now the needs of a nation geared to war make it a vital patriotic duty to burn oil efficiently. Frequently, as in our plant, changes made to increase boiler and furnace efficiency give added boiler capacity, too.

Four longitudinal 4000-sq-ft 2-drum boilers were installed in our plant, with settings like Fig. 1 arranged for oil firing. The solid, overhung, front wall had three mechanical-atomizing burners set in its lower half, at right angles to it. Side walls were solid, with the bridgewall placed only 8 ft from the front one. When we started burning oil our troubles started, too.

Brickwork deteriorated rapidly under the effects of flame impingement on side walls and bridgewall, combined with excessive furnace temperature, caused by the small furnace volume (744 cu ft). Repair of melting and spalling brickwork soon became a steady grind because we made the repairs ourselves. Side walls, bridgewall and front wall all required constant attention. To add insult to injury, maximum continuous rating of the boilers was only about 75% of normal. On peaks we had to shut off the feedwater, open the damper and lay down a smoke screen that would have hidden the Atlantic fleet.

It was evident that the furnaces needed enlarging so we moved the bridgewall back three feet on one furnace to increase its volume to 997 cu ft, Fig. 2. Results were encouraging. Brickwork maintenance was cut practically in half and continuous steaming capacity jumped to 100% so that peak loads could be carried without trouble.

When we were satisfied that we were on the right track we moved the bridgewall back two feet more, Fig. 3, increasing the furnace volume to 1210 cu ft. Brickwork maintenance again decreased and the continuous steaming rate of the boiler increased to 120%.

Success with our experiments gave us courage to redesign the whole boiler setting.

We took out all the walls and the floor of the furnace. When we rebuilt it, we placed the burners in the wall under the low end of the boiler, Fig. 4, instead of under the high end, Fig. 3. In the floor, across its full width, we built an air duct, using a layer of 4-in. 2-section hollow tile. This duct extended from the outside wall under the high end, back to a checker work under the burners.

Under the high end of the boiler we built a solid wall cobbled out at its base to give stability. To cool this wall we provided a 4-in. air duct between it and the steel casing, with an air inlet near the top of the casing, as in Fig. 4. At the top of the wall the header blocks which had been a source of trouble because they spalled and fractured, were replaced by firebrick. Side walls were also provided with a 4-in. air duct between casing and brickwork. This duct we baffled with brick, as in Fig. 5, to direct the air to the checker work under the burners.

Under the low end of the boiler we installed the burners in a new plate that set the outside burners to direct the flame away from the side walls, see Fig. 6. We removed the *C* blocks above the old bridgewall and extended the tile roof above the bottom row of tubes, from the baffle back to the rear header, see Fig. 4. This gave us a large furnace along whose full length the flame traveled in a clean sweep before entering the first pass of the boiler. To remove the soot that collected on top of the tile roof, we moved the back soot blower to the third row of tubes. Exposing the bottom row of boiler tubes for their full length to radiant heat and increasing the volume to 1400 cu ft kept furnace temperatures within safe limits, even when forcing the boilers. We can now easily operate the boilers at 150% of rating continuously and go to 180% on peak loads without trouble. After a year's operation the brickwork is in good condition so we now feel that our experiments have proved successful.

The air-cooled furnace walls and floor remove some of the heat that soaks into the brickwork. This heat, which ordinarily would be released into the boiler room, preheats part of the combustion air and is taken back into the furnace to help improve boiler efficiency. Less material is needed to construct air-cooled walls than solid walls. Side walls, because of the baffles, take a little longer to build but floor and front walls are as easy to build as when an air duct is not provided.

Further improvements, such as placing the tile roof above the second row of tubes and bringing the preheated air into the burners instead of into the furnace under the burners, have been contemplated but so far the changes have not been made.

This broad outline of the way we solved our boiler and furnace troubles, even without details of what we did and how we did it, may help others in solving similar problems, particularly where added boiler capacity is needed.

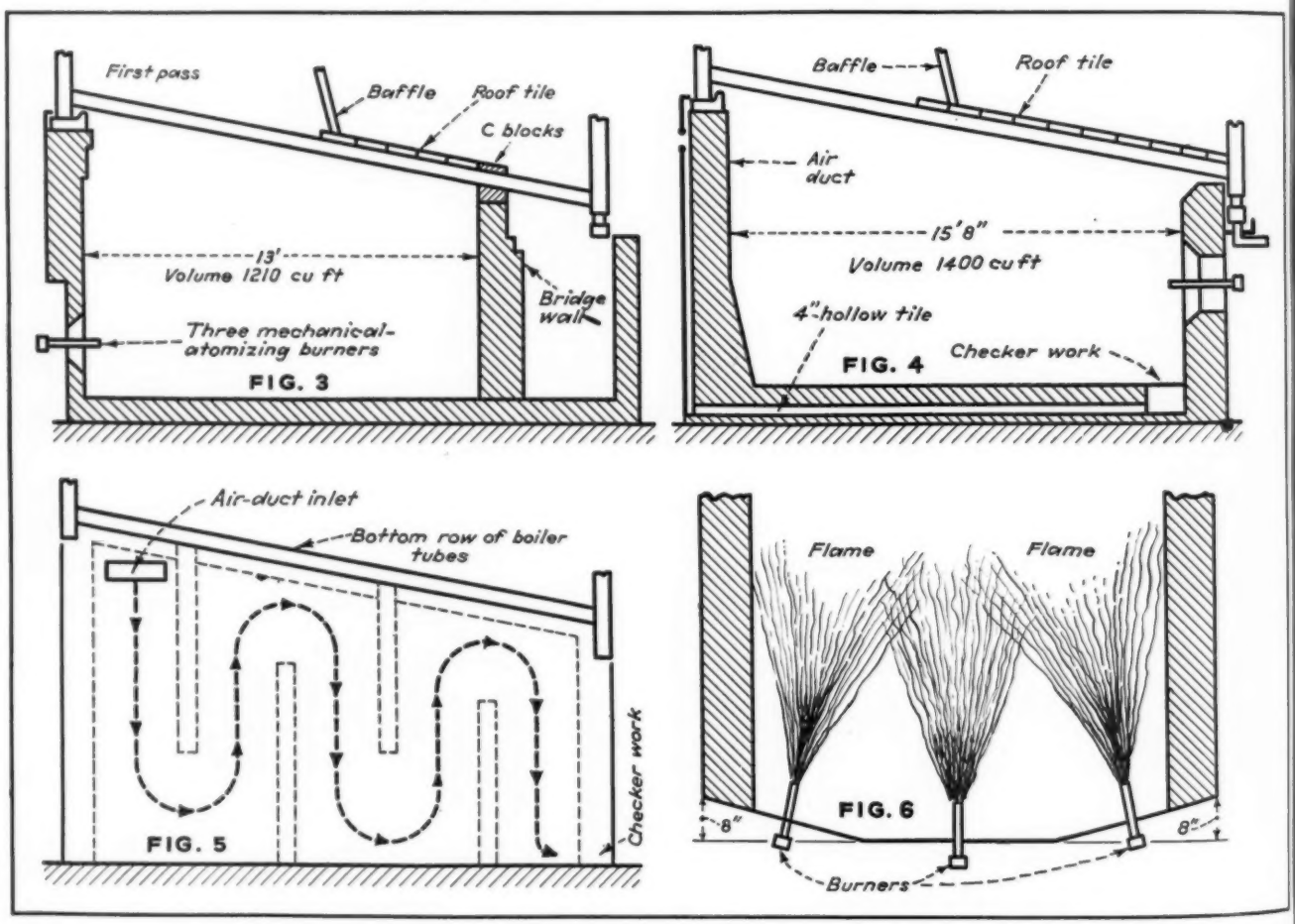


Fig. 3—Another lengthening of the furnace increased its volume to 1210 cu ft and raised boiler rating to 120% of normal. Fig. 4—Completely rebuilding the furnace and placing the oil burners under the low end of the boiler increased its capacity to 150%. Fig. 5—Combustion air path in the furnace sidewall ducts. Fig. 6—Burners were set under the low end of the boiler with the two outside ones set at an angle toward the center line of the furnace

REFRIGERATION NOTEBOOK — 1

Practical Tips on Proper Handling of FREON-12

By TERRY MITCHELL, ME, *Frick Company*

▸THIS MONTH *we add the name of Terry Mitchell to the list of leading specialists who are giving you their best in training, experience and service. He begins a series on operation and maintenance of refrigeration equipment, dealing briefly and simply in each article with one part of the refrigerating engineer's job.*

Freon systems require different treatment from those charged with ammonia. Coils and pipelines must be kept absolutely dry. Design and operation must allow for the fact that oil and Freon dissolve in each other. Suction conditions must be different for best results. Here are some practical tips on these peculiarities.

To keep coils and pipelines dry: Avoid pumping an air pressure on a Freon system because moisture enters with the air. When adding oil to the compressor, do not create a vacuum on the crankcase; pump down until only a slight pressure remains, then open the oil-filling valve and use a funnel for pouring in the lubricant. Lubricating oil must be dehydrated and should be kept in airtight cans.

Remove Driers Promptly

Make sure that the driers put in the pipelines are removed after the first twelve hours of service. Further use slacks out the alumina as a white powder, which passes through the retaining screens and accumulates at the expansion valves where it hardens into a putty-like mass and makes endless trouble.

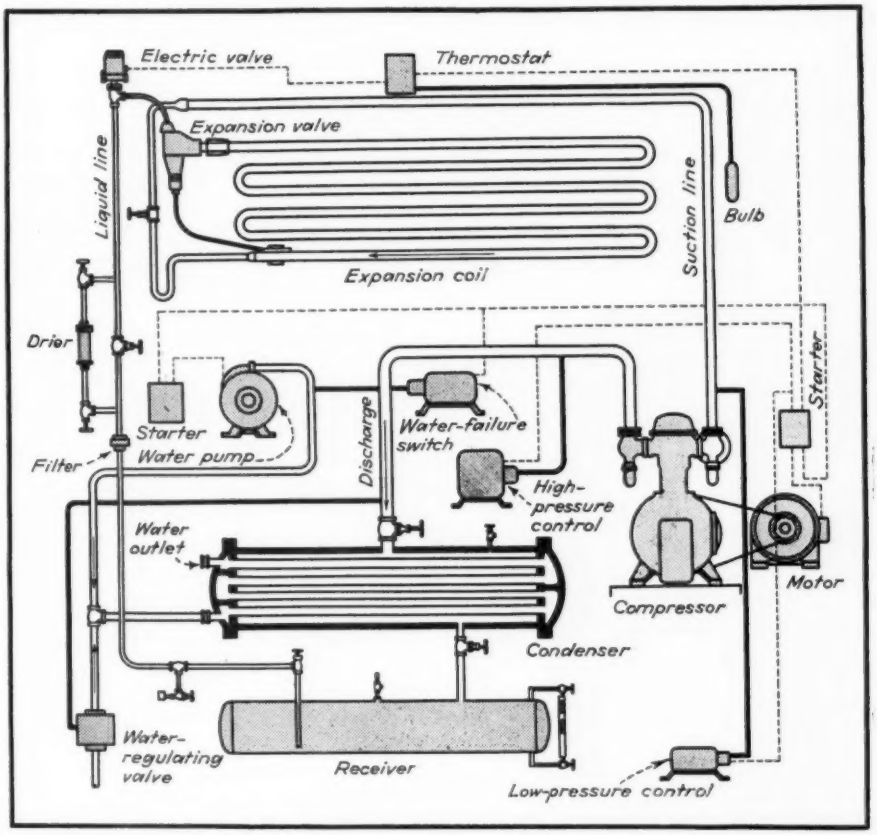
Freon's cleansing action loosens any scale or dirt left in the system, clogging valves, strainers, etc. Install a scale trap or "sump leg" at the bottom of one of the liquid lines. Clean the strainers regularly and often.

Freon and oil dissolve in each other: hence a Freon compressor may need a heavier oil than an ammonia machine. Crankcase oil ultimately carries over with discharge gas. Add oil to the machine until enough comes back with the suction to keep the level showing at the right height in the gage glass. However, oil tends to collect in coils and coolers, because pressures there are lower. Pure Freon at 10 psi suction boils at approximately O F; a mixture with 10% oil boils at 2.5 F; with 20% at 4 F; with 30% at 6 F and with 40% at 8 F. An efficient oil-return system, or periodic draining, keeps the efficiency of the entire system from falling off.

Appearance of oil at a Freon-system joint means that refrigerant is leaking and evaporating at that place. If two compressors connect to the same cooler, some positive arrangement must be made to keep enough oil in the crankcase of each. Pumps handling liquid Freon depend on the oily liquid for lubrication and must not be run when the Freon charge is absent or even low.

Shaft seals of some Freon machines are supposed to be lubricated with oil from the adjacent bearing. Too often there is no clear passageway above the seal and it becomes so gasbound that little or no oil can reach it. If it appears dry when inspected, the seal needs a hole or groove drilled in the top of the bearing or through the housing leading into the crankcase.

Different suction conditions: Superheat in the suction gas proves fatal to economy in the average ammonia system, but from 10 to 30 F superheat is felt to be a positive advantage with Freon. This is partly because one pound of Freon evaporating at a normal suction pressure of 20 psi absorbs only 68 Btu unless superheated; a pound of ammonia under the same pressure takes up, theoretically, 565 Btu. Freon gas is heavy, some five or six times as heavy as ammonia at the same temperature. Liquid Freon coming back to the machine may cause it to pound severely and will likely get down into the crankcase, thinning the oil. So do not carry a frost on a Freon machine. Watch the thermometers and gages to make sure there is superheat in the suction.



Layout of a typical Freon refrigeration plant under full automatic control

PRACTICAL AIDS TO OPERATION

Hand Drill Substitutes For Speed Counter

WHILE ON HOLIDAY recently the writer was asked by the maintenance engineer of the local hotel to assist in adjusting the flywheel governor of the engine driving one of the lighting generators. The generator was designed to run at 300 rpm and no tachometer was available to check the speed accurately. It was not practical to mark the flywheel and count the revolutions visually as the speed was too great; so some method of reducing the speed was sought.

A small hand drill was obtained and a small pointed piece of wood inserted in the chuck. The ratio of the bevel gears on the drill was found to be 4.25 to 1, and the drill was used as a tachometer as in the photo (posed in another plant), proving to be very satisfactory. When the engine ran at 300 rpm the handle of the drill rotated at about 70.5 rpm at which speed it could be easily timed with the second hand of a watch. The governor was accurately set without any difficulty for lack of a speed counter.

Kenogami, Quebec A CUNNINGHAM

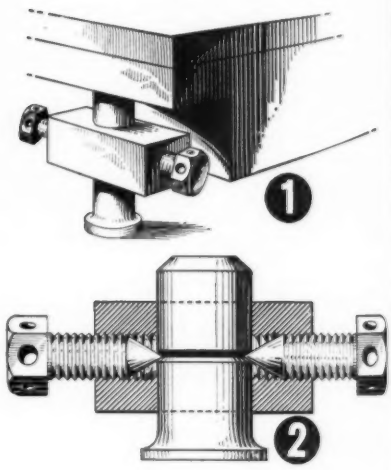
How to Check an Indicator Reducing Motion

MANY STEAM engines and pumps formerly laid up have lately been put back in service. Proper operation of this equipment depends upon many factors. Most of these may be checked by an indicator. The accuracy of an indicator diagram in turn depends upon a reducing motion which will impart a motion to the indicator drum proportional to the movement of the piston. Drum circumference and stroke of engine are rarely equal, hence a reducing motion must be used.

Many reducing motions are subject to errors, because they do not give a motion to the drum which is exactly proportional to the motion of the piston. To test the reducing motion, the indicator should be attached to the cylinder without its spring. With the crank on either dead center, raise the pencil arm and trace a vertical line on the card. Divide the length of the stroke into a number of equal parts, say five, by means of marks on the crosshead guide and a mark on the crosshead.

Jack the engine over and trace a vertical line on the card every time the mark on the crosshead coincides with a mark on the guide. When the piston has reached the opposite dead-center position there should be six vertical lines on the card. The ratio of the distance between any two vertical lines on card to the total drum travel should equal the ratio of the corresponding fraction of the piston stroke to the total stroke. If these ratios are not equal it is probable that the reducing motion is not accurate and steps should be taken to correct it.

New York, N. Y. TYLER G HICKS



Small Jack for Tight Places

TO START STUBBORN bolts and dowels in close quarters generally proves difficult unless proper tools are available. For such work I built the small jack shown in the diagrams. It consists of two hardened-point screws threaded into a steel block. A divided plunger passes through the block at right angles to the screws. The inner ends of these plungers have a slight bevel for the points of the screws to enter, as in Fig. 2. To use the jack it is set up as in Fig. 1 and the points of the screws are forced between the plungers to separate them. This tool will be found to

be a useful part of any mechanic's tool kit doing repair or overhaul work.

Penacook, N. H. C H WILLEY

Water Legs Improve Heating-System Operation

IN THE 19-STORY Washington Life Building, 141 Broadway, New York, the heating system was originally arranged with traps in the basement or on the lower ends of the condensate-return lines. These traps discharged into a header and to the feedwater heater. This arrangement never was satisfactory. It frequently was difficult to heat the lower floors because of flooded radiators, at other times the feedwater heater was flooded and it required a backpressure on the engines of 4 to 5 psi to heat the building in cold weather.

Under the direction of Ralph B Allen, chief engineer and building superintendent we installed a condensate-return tank as in Fig. 1 and automatically pumped the water from it into the feedwater heater. Even though this arrangement was a big improvement over the old conditions, operation of the heating system was not all we desired.

A second and final improvement gave the result we were looking for. At the bottom end of each condensate-return line we installed a 6-ft water leg to trap the condensate into the return tank, as in Fig. 2 and the photo. Now we can heat the building with ounces of steam pressure where pounds were required before. Flooding of the feedwater heater has been eliminated also.

In cold weather live steam for heating has been practically eliminated. Before the water legs were installed, even at night, exhaust from the engine supplying the power load was not sufficient for heating, live steam being required in cold weather. Now the exhaust is more than ample even in the coldest weather. The change in the heating system saves us between $1200 to $1500 per year in the cost of live steam alone. Also, heating of all parts of the building is highly satisfactory and power-plant operation has been improved.

New York, N. Y. ALBERT FISCHER

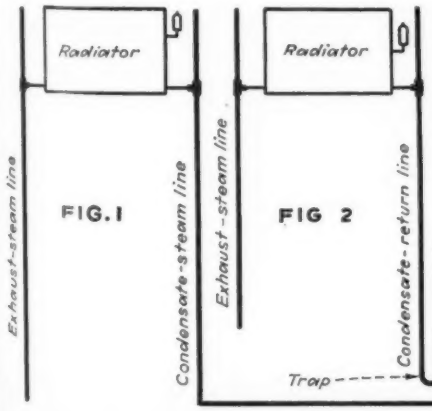


FIG. 1

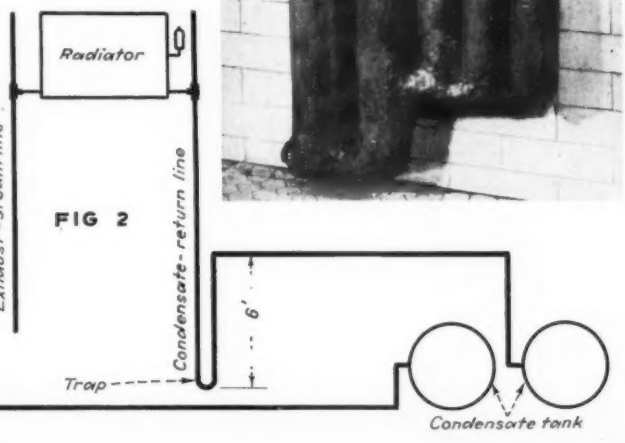
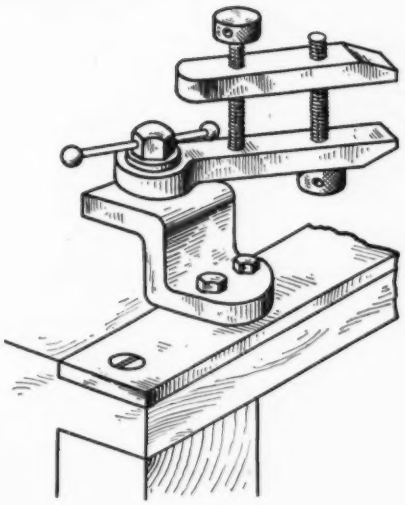


FIG 2

Handy Design of Bench Clamp

THE DRAWING SHOWS a clamp that I made for holding small parts when working at my bench. The clamp is



of the parallel-jaw type with an eye in its lower jaw for supporting from a bracket secured to the bench. I have found the clamp a very convenient tool because it will hold quite large parts of light construction and can be swung horizontally to any position for easy working.

Penacook, N. H. CHAS H WILLEY

Graphite and Oil—Engineer's Friend

OIL AND GRAPHITE made by stirring powdered (not flake) graphite into steam-cylinder oil and thinning with a small quantity of turbine or bearing oil to the consistency of heavy cream is one of the most useful tools available to engineers. This mixture is ideal for such jobs as doping gaskets and ground-joint surfaces used in high-temperature service which must be kept separable. Even though high temperature boils off the oil the graphite remains to serve as a lubricant. Joints properly coated with this mixture come apart easily and in most instances the gasket is left intact so that it can be reused.

Typical applications of this dope are its use on boiler manhole and handhole gaskets, pipe gaskets, bolt threads, painting surfaces of split-casing pumps and ground-joint fittings. It is an ideal lubricant for reciprocating-pump rods, rising valve stems, and packings. If sections of packing are dipped in the graphite and oil mixture before installation they will remain soft and usable for a long time.

When using the mixture to lubricate bolts or cap screws do not immerse the whole thread. Paint the ends of the threads alone and when the nut is applied the lubricant will spread.

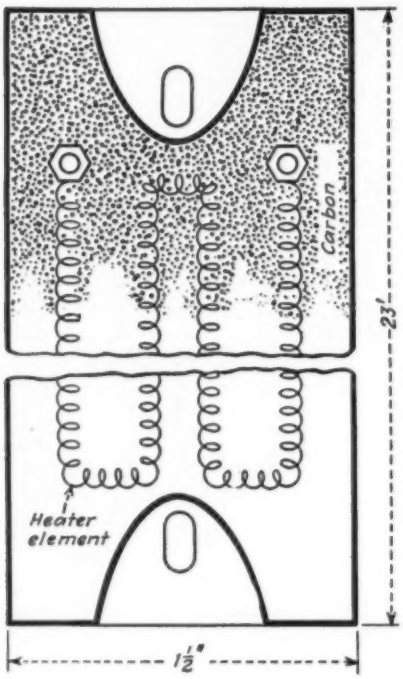
When it is desired to make semi-permanent joints, powdered graphite

stirred into triple-boiled linseed oil or heavy oil makes the ideal dope. When compressed in a ground joint and heated, the oil bakes into a heavy gummy film holding the graphite in suspension. This film seals but does not lubricate. It should be applied immediately after mixing and when it is warm, as it becomes stiff when cold and cannot be left open to the air.

Staunton, Va. S H COLEMAN

An Electrical Heater Short-Circuit Mystery

WE HAVE A BANK of 20 electrical strip heaters under a hot-asphalt vat. One day the asphalt accidentally overflowed,

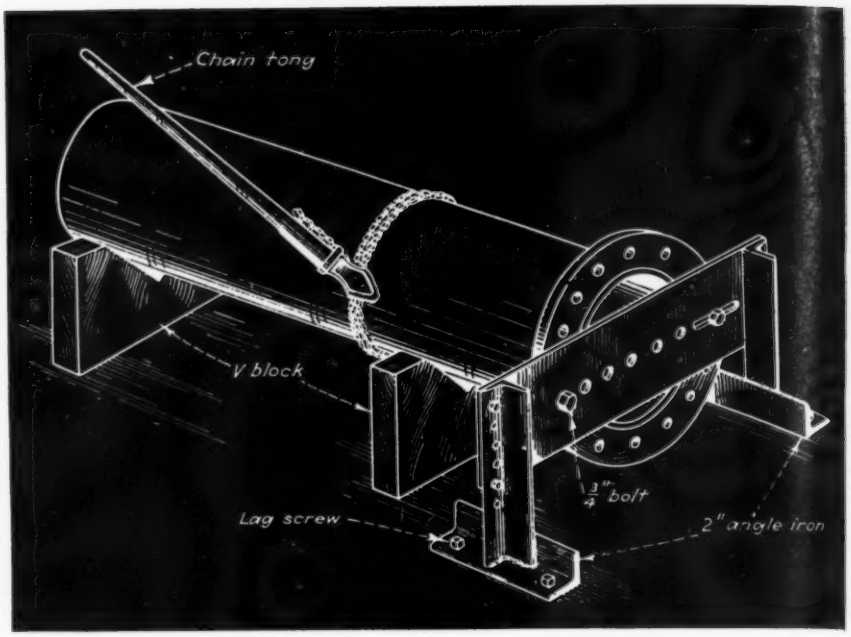


ran under the vat and submerged the heaters. The heater units were bricked in so that we did not know that they were submerged until later when the fuse started to blow. When we removed the heaters we found all connections in good condition with no signs of short circuits between them. When tested we found each heater short-circuited across the loop within its sheath.

Opening up the sheath of each heater, we found the white-silica filling powder, tar-blackened for several inches at the connection end of the strip, as in the figure. Heat liquefied the asphalt to the point where it had entered the heater sheaths. This probably resulted from a breathing action. When high temperatures existed the air expanded and part of it was driven out of the sheaths. When the heaters were disconnected and allowed to cool, the air in them contracted to form a partial vacuum and draw asphalt into the sheath. This process continued until the fuses started to blow.

Dry asphalt, however, is not a conductor, so finding it in heater did not answer our question as to why the asphalt had short-circuited the heaters. One day while examining some of the heating elements, trying to find an answer to the short-circuit I discovered that what looked like tar-consolidated silica was a coke-carbon substance. High heater temperature had driven off all volatile in the liquid asphalt and had burned the residue to carbon, a conductor. This solved the puzzle.

Vancouver, B. C. R MANLEY ORR



Pipe Work Simplified by Flange Holder

COMMON PRACTICE when making up screwed flanges on pipe is to hold the pipe stationary. Then, after the flange has been started, tighten it in place with a bar resting on pins or bolts in holes or opposite sides of the flange. This method has the objection that the bar or pins may slip.

To eliminate these difficulties in our plant we built the flange holder shown in the figure, out of material from the scrap pile. This holder is adjustable for any size pipe up to 12 in. and holds the flange stationary while the pipe is being threaded into it. It can be moved from one place to another simply by removing four lag screws.

Prescot, Ore. J A OBERSTALLER

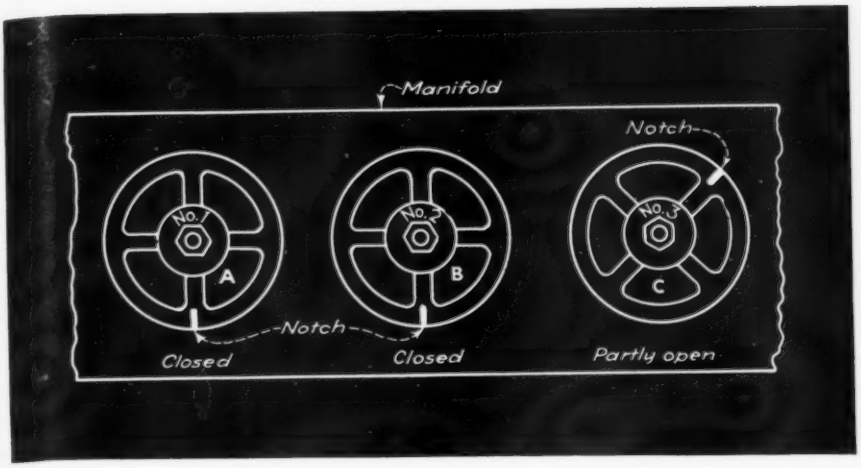
Easily Made Rust-Penetrating Mixtures

IF A STANDARD PENETRATING OIL is not readily obtainable when it is needed to loosen tight parts like bolts, nuts, pulleys or shafts, keys, pipe fittings and the like a very good substitute can be made by using either one or the other of the following formulas: (1) ⅓ kerosene, ⅓ spirits of turpentine and ⅓ light machine oil. (2) ¼ ether, ½ kerosene and ¼ light machine oil. Where available, liquid hydrocarbon compounds that collect in pockets of coal-gas mains also make an excellent rust-penetrating material. This is particularly effective on parts, such as steam-line flange bolts at elevated temperatures that must be loosened.

Chicago, Ill. R C HENDERSON

Tools Recover Lost Deepwell Suction Pipe

AT AN ISOLATED POWER PLANT the engineer lost half of the suction pipe down a 300-ft well. After working for two days trying to recover the pipe with chain slings and ropes without success he called on me for advice. I am em-



Marked Handwheels Show Valve Position

IN AN OIL REFINERY crude oil was pumped from several tanks through a large valve manifold. Frequently a pump would lose its prime because an obstruction under a valve prevented its complete closing. Then air was drawn from an empty tank into the pump to prevent its proper operation. These obstructions were usually a piece of rag or wood and in one case a bolt that prevented a valve closing. It was easy enough to remove the obstruction, but the problem was how to know which valve to dismantle.

At times we opened a number of valves before we found the one causing the trouble, because the faulty one might be open only one-quarter turn. This problem was solved by making sure that each valve was properly seated, then filing a notch in its wheel to mark this position, as at *A* and *B* in the figure. An obstruction under a valve prevented its handwheel from coming to its correct closed position, as at *C*. The valve bonnet could then be immediately removed and the stoppage taken out. The notches certainly made our lives around the refinery a little more pleasant.

Great Neck, N. Y. S M ELONKA

ployed with a large salt company operating nine wells 1200 ft deep, and we have developed several tools for recovering pipe from these wells, even when they are broken and corroded away.

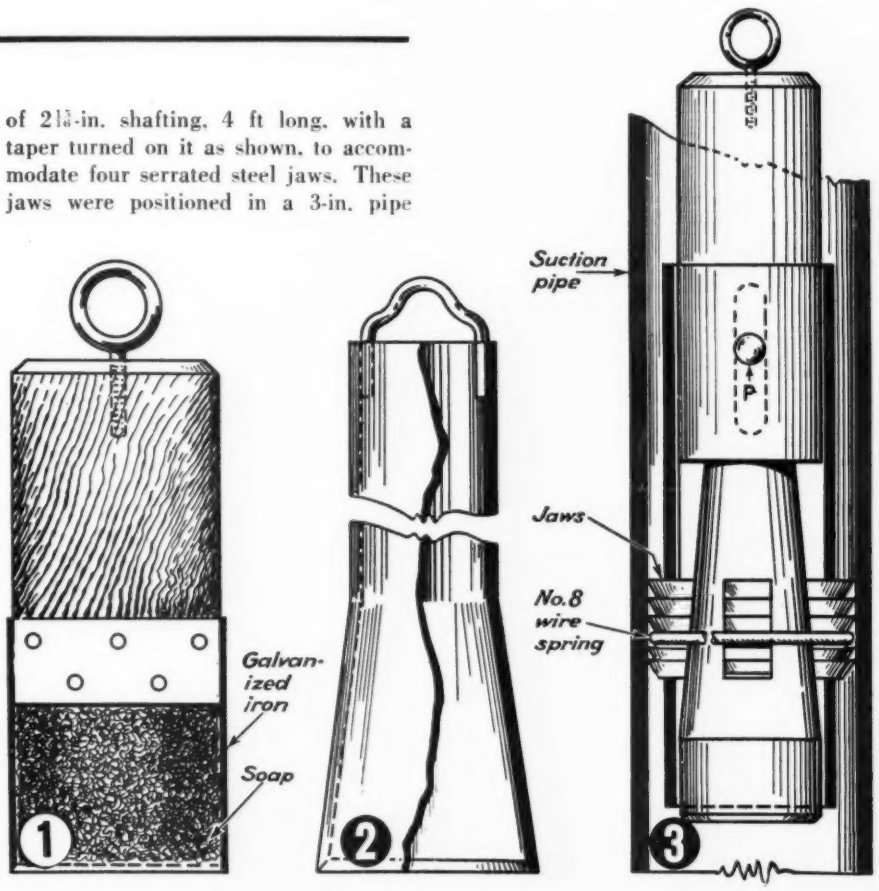
On the isolated-plant job we made a wooden plug with a metal ferrule extending out over one end, to go into the well. This ferrule we fastened to the plug with nails and filled it with soap, as in Fig. 1. We lowered the plug into the well and obtained an impression in the soap of the condition and location of the top end of the pipe. From the impressions in the soap we found that the pipe had pulled out of its threads and was leaning against the side of the casing. The suction pipe was 4 in. in diameter. Lowering in the well a 16-ft length of the same size pipe, belled at the lower end as in Fig. 2, we were able to center the top end of the suction pipe in the casing. This was determined by lowering the soap gage into the well.

Fig. 3 shows the tool used to connect the suction pipe and pull it out of the well. This tool we made from a piece of 2⅛-in. shafting, 4 ft long, with a taper turned on it as shown, to accommodate four serrated steel jaws. These jaws were positioned in a 3-in. pipe sleeve slotted to locate the jaws on the taper and for holding pins *P*. A spring made of a single strand of No. 8 steel wire was placed around the four jaws to hold them in place.

Before lowering the puller into the well we measured the distance down to the top of the suction pipe. Then when the puller was lowered and approached the top of the pipe we controlled its speed accordingly. We could tell when the tool rested on the top of the pipe by the cable going slack. Preparatory to lowering the tool into the well we pulled the sleeve on it to its uppermost position; then the jaws rested on the smallest part of the taper and were within a circle not much larger than the sleeve.

Because of the position of the jaws when the tool landed on the top end of the pipe a few shakes of the cable caused it to drop inside the pipe. When this happens a jar can be felt on the cable when the sleeve is pulled up on the tool until the jaw contacts the inside of the pipe. The tool is then lowered into the pipe far enough for the jaws to get a good solid hold. When the cable is tightened to take the lift the jaws are forced outward against the pipe by the taper. The harder the pull the more securely the jaws dig into the pipe, insuring that if you once get a hold on the pipe it won't slip.

Goderich, Ont. GEORGE BARRETT



READERS' PROBLEMS

Questions from Our Readers

Steam Instead of Hot Water

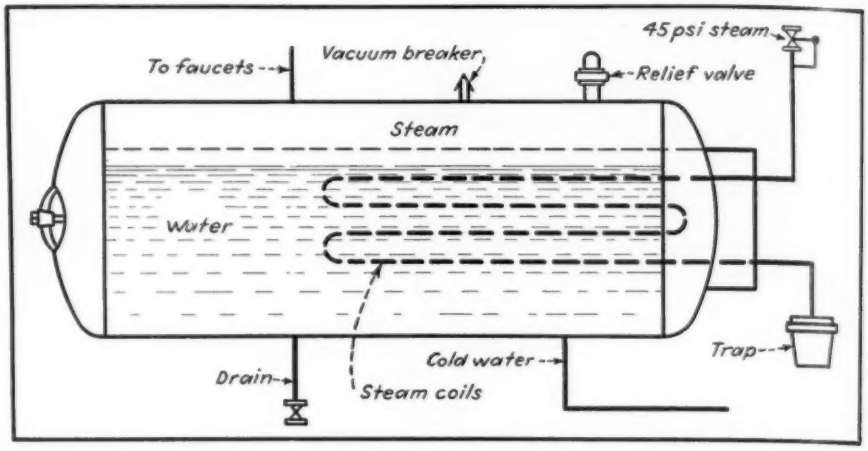
Question 1

WE RECENTLY INSTALLED *a hot-water tank to furnish domestic water for wash rooms. The tank is piped as shown in the sketch with heating coils extending about two-thirds the tank length.*

The tank holds 500 gal of water and steam is supplied to the heating coils at 45 psi through a regulating valve.

When the hot-water faucets are opened water flows for about 5 min and then turns to steam. After allowing the steam to blow for about one hour the faucet then discharges cold water.

I have inspected the heater and have been unable to find any steam leaks in the heating coils. What can be causing this unusual condition?—DJM



Must These Boilers Be Replaced?

Question 2

WE HAVE IN OUR POWER PLANT, *two 150-hp hrt boilers built in 1909. They have been in continuous use since that time for about nine months of each year, operating at 120 psi. Insurance carriers now decline to permit use of more than 15-psi steam on these boilers because of their age. Thorough inspection has shown no evidence of any embrittlement; there is no active pitting; the flues are in good condition, and all rivets are tight. In fact they are in first-class operating condition but are guilty of the crime of being old.*

Is there any test by which we may determine possible areas of embrittlement? Are these boilers excessively old for safe operation? May we expect high efficiency at the lower pressure? Are we justified in going to the large expense necessary to change from steam-driven pumps and steam engines for the forced-draft system to motor-driven units with these old boilers? Can we reasonably expect to continue service as usual at 120 psi for two or three years longer until the war emergency is over? The comment of experienced readers on these problems would be very much appreciated?—CJJ

Needs Fuel or Heat Storage

Answers to Feb Question 1

The Question

I HAVE AN HRT BOILER *72 in. by 18 ft which we ordinarily fire with oil. For a period of six hours during each day we dispose of asphalt fumes by burning them under this boiler. They are supplied to the boiler at 500 F and 3 psi by a blower. When using the fumes for fuel the oil burner is adjusted to maintain only enough flame to ignite the asphalt. To keep the steam pressure down requires bleeding steam through a 2-in. line, usually wide open, into a large concrete pit of water.*

During the remainder of the day we use very little makeup water so it is impossible to utilize the heat discharged to the condensing tank water. Is there any way that we can store this steam or the asphalt fumes to allow operation without wasting steam? If storage is impossible how can we dispose of the excess fumes above the amount needed for ordinary load conditions?—HEF

Install Gas Reservoir

HEF DOES NOT SAY what kind of load his boilers supply so it is difficult to suggest any definite change in operation. Although he wastes steam during six hours each day the operation still may be on a low cost basis because of burning waste fuel.

If this gas is available only during the 6-hr period one solution would be to install a gas storage tank. Excess gas could then be stored for use during the remaining hours of the day which would give a corresponding reduction in fuel-oil consumption.

Another solution would involve using spare boilers or other suitable vessels as accumulators to store the excess steam. It would be necessary to provide these accumulators with adequate insulation to prevent excessive condensation. Naturally these vessels must pass insurance inspection.

Perhaps he could arrange to supply neighboring plants with excess steam above that needed in his own process or, as another alternative, he might be able to substitute steam engines or turbines for motors if his plant operates on purchased power.

Unless this excess steam can be used in some manner the asphalt fumes should be burned or disposed of by some means other than burning under the boiler. Since the steam discharges to waste added duty is placed on the boiler for no good purpose. Burning the fumes in a separate furnace would certainly reduce boiler maintenance as well as eliminating the need of treating large quantities of feedwater makeup.

The waste furnace could be constructed cheaply with a connection to the present stack. Since the stack now handles all the gas no appreciable loss in boiler draft should occur when burning the fumes in a separate furnace. Why not use open air burners?

New York, N. Y. R M RANSING

Connect With Nearby Plant

TO HAVE a 2-in. steam line blowing to waste seems an inexcusable condition at any time but in this time of emergency it is much more so and demands

one's best efforts to conserve this loss.

HEF does not state what steam pressure is carried but it might be worthwhile considering the installation of a steam accumulator from which steam may be drawn when required. He should also consider the possibility of running this line to any nearby plant where the steam can be used and paid for as metered.

Should it be found impossible to follow either of these suggestions then it might be wise to consider storing the gas, which is apparently of very high heat content. An ordinary gas accumulator or retort such as used for storing illuminating gas would be suitable for this purpose and could be made of light material sufficient to withstand 10 psi.

Another solution may be that of storing the gas under high pressure in a vessel or vessels of sufficient strength to safely withstand the pressure. This of course would call for some capital investment. The gas thus stored could then be drawn on to replace the fuel oil, using only enough oil to keep the flame burning.

Justification for the investment on any of these arrangements depends on the size of the plant, how long it may be in service and whether the asphalt fumes may be available for long.

Before making a decision it is advisable to consult manufacturers of these various pieces of equipment as to their adaptability for service with this gas. Also consult the insurance company and license bureau.

If none of these methods can be used the only way to dissipate the gas would be to run a line up the outside of the plant smokestack and allow the gas to flow to atmosphere if the local health authorities will permit this form of disposal.

Kearny, N. J. GEORGE MCNALLY

Use a Steam Accumulator

IF IT IS ASSUMED that HEF generates steam at 125 psi and the waste is 3000 lb per hr then this steam used in an engine exhausting to atmosphere would develop 30 to 40 hp. Also in the 6-hr period the value of the steam lost, based on purchased fuel would be $0.50 per 1000 lb or $2700 per year of 300 days. The value is sufficient to justify a considerable investment to obtain partial or complete saving.

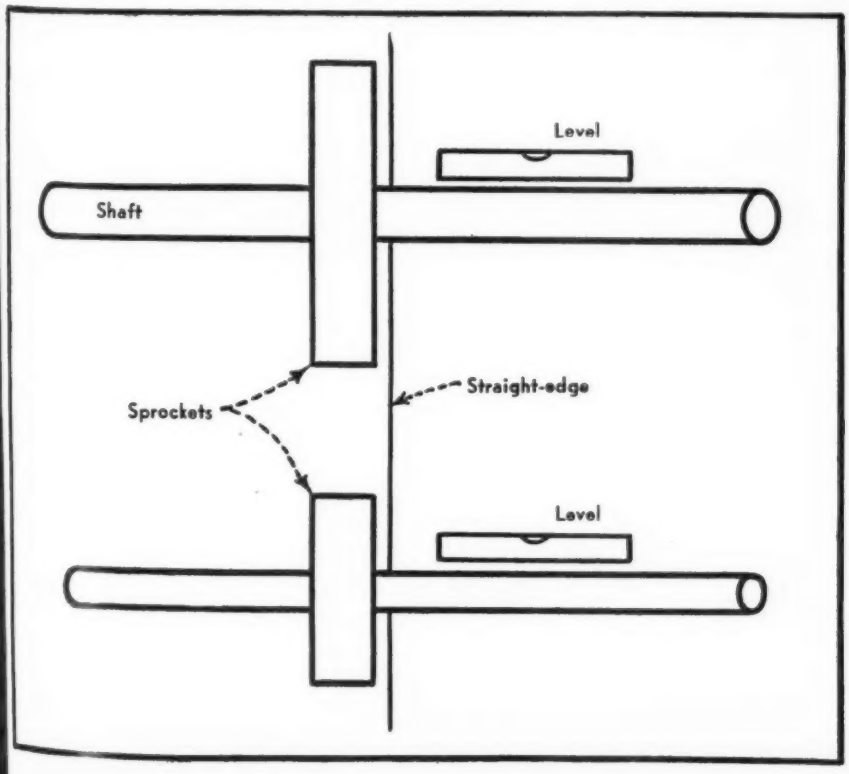
If there is a use for this quantity of steam at a lower pressure it can be stored in an accumulator. The greater the range between the pressure at which the steam is generated and used the smaller will be the accumulator required. Complete details of steam production and use over a 24-hr period are necessary to determine if such an installation is practicable. It is improbable that an accumulator with the necessary control equipment could be purchased at present.

Storing the fumes would be more difficult than storing the steam, as the vessel required would be so much larger even though built for lower pressures.

From the information given it would seem logical to develop the use of excess steam for power purposes. This could be done by installing an engine or turbine-driven generator set to augment plant electric power supply or by replacing existing motors with steam engine or turbine drives. A good deal of the equipment required could be obtained secondhand. Steam would then be wasted at or near atmospheric pressure if no use for process or other heating could be found.

The excess fumes, after generating all steam that can be effectively used, can be burned in a simple furnace discharging to the stack beyond the boiler damper. Present stack details would determine the maximum allowable temperature of stack gases. This value can be controlled by dilution with air up to draft capacity of the stack.

St John, N.B. C G CLARK



Maintenance of Chain Drive

Answers to Feb Question 2

The Question

WE HAVE SEVERAL *chain drives in our plant, some being of the so-called silent drive and others of the roller type. What is the best method of checking the alignment to obtain the best service from these drives? What allowance must be made for tooth wear to prevent the chain from riding or jumping pinion teeth?—AGF*

Observe Condition of Chain Guide Links

MINIMIZING MAINTENANCE and interruptions of chain drives begins with the proper selection as to the service, pitch, ratio, fpm, and degree of wrap. In my opinion pages could be written covering this subject but I shall confine myself to chain-drive maintenance. Sprockets and shafts should be checked to be sure they are parallel, level and in perfect alignment; this can be checked with a straight-edge, fine piano wire or string across the face of the sprockets. Silent-chain drives can be rechecked by observing the guide links in the chain; the wear should be equal on both sides of the guide links. If the alignment is not right the fault will show itself quickly by the wear on either side of the guide links. (See sketch at left.)

As to the tension of the various chain

drives, this is a little difficult to prescribe, because they do not depend on tension for traction or transmission; nevertheless a chain should be tight enough to avoid whipping. Personally, I can not overemphasize the importance of arranging chain-drive installations with adjustable centers in order to maintain uniform amount of slack.

Shaft center distances should be so selected as to avoid the use of hunting or socalled offset links. Care should be taken that new chains are lubricated at more frequent intervals until the chains are run in. For drives subjected to grit or dirt, oil-retaining chain casings are advisable; perhaps a dustproof enclosure with oil drip feed is sufficient. As to inspection or preventive maintenance, chain drives, like any other machinery, require periodical inspection. Watch the rigidity of the installation, also alignment and lubrication; the time and effort spent for such inspections will be compensated by satisfactory uninterrupted production and increased life. However, for special drives it is the best to consult the manufacturer since he is the best authority in this field.

Schenectady, N. Y. CARL BACHMANN

Reverse Sprockets for Additional Wear

AGF CAN READILY obtain complete instructions for installing and maintaining chain drives from the equipment manufacturers.

The best method of checking alignment will vary with the installation details and instruments available, but in general will be as follows:

1. Remove guard or chain case top and chain.

2. Using an accurate spirit level check both shafts and adjust as necessary to make both horizontal.

3. With an accurate straight-edge or a wire stretched taut in contact with the finished sides of the sprockets, check and adjust sprocket location until contact is made over the entire face of both sprockets. If either shaft can float endwise the mid-position should be used for checking alignment.

If sprocket teeth wear in the form of a hook they should be filed or ground to remove the projections. In many cases sprockets can be reversed to obtain additional service. Sprockets which are worn so that the chain rides or jumps should be renewed, first checking alignment and actual load if wear is not excessive.

St John, N. B. C G CLARK

Sprockets Must Fit Shafts

UNLIKE A FLAT BELT, which may give good service even although slightly out of line, a chain drive must be absolutely true to give good results. Before checking alignment see that the chain wheels are a good fit on the shaft so that on being keyed up they will not tend to run eccentric.

To insure sprockets being parallel, place a straight-edge along the edges across both wheels and, using feeler gages, set them to the line. Also check by placing a pair of straight-edges across the faces of and extending beyond the teeth and measuring by trammel, between these two straight-edges. The longer the straight-edges the more accurate they will measure.

Another important factor in chain drive is that they should be set longitudinally level otherwise the chain will have a tendency to ride off to the lower side of the wheels with undesirable consequences. This setting is done by using straight-edges over the top of the wheels and applying a level.

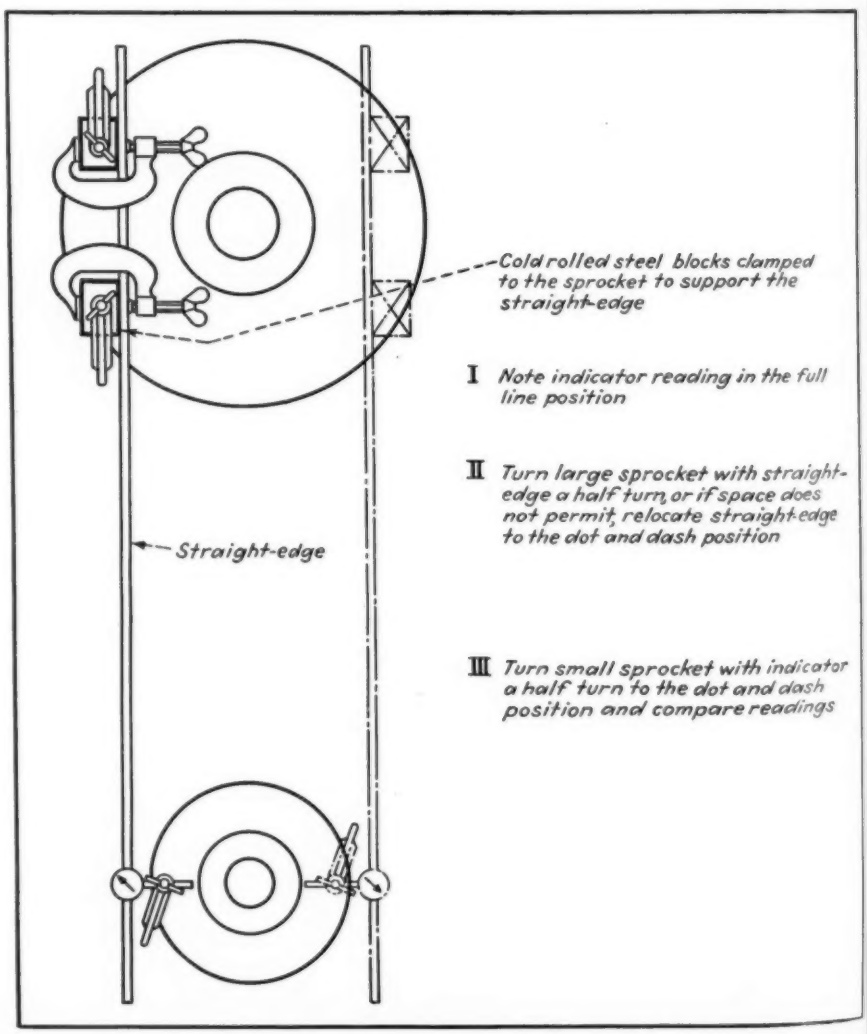
All chain drives should be carefully protected against the possibility of any material being caught in them both for the safety of the personnel and the drive. Carelessly dropped tools landing into a chain drive can cause very serious damage.

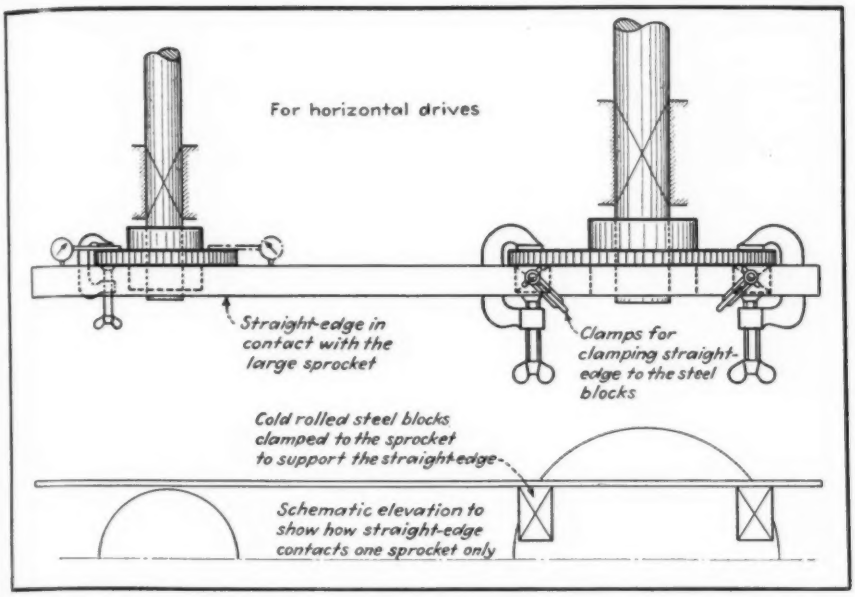
Lubrication may be applied either by drip or by having the lower part of the chain dipping into an oil bath.

Kearny, N. J. GEORGE MCNALLY

Use Straight-Edge and Dial Indicator

TO CHECK chain sprockets for alignment, first make them plumb in the vertical plane. For horizontal drives or those approaching a horizontal position the procedure for checking the alignment is to place a straight-edge against one of the sprockets and to clamp a dial indicator to the other sprocket as shown in the sketch. With the indicator contacting the straight-edge, any misalignment will be noticed by different readings of the indicator when the latter contacts the straight-edge, as shown in sketch on page 117.


Cold rolled steel blocks clamped to the sprocket to support the straight-edge
I Note indicator reading in the full line position
II Turn large sprocket with straight-edge a half turn, or if space does not permit, relocate straight-edge to the dot and dash position
Straight-edge
III Turn small sprocket with indicator a half turn to the dot and dash position and compare readings

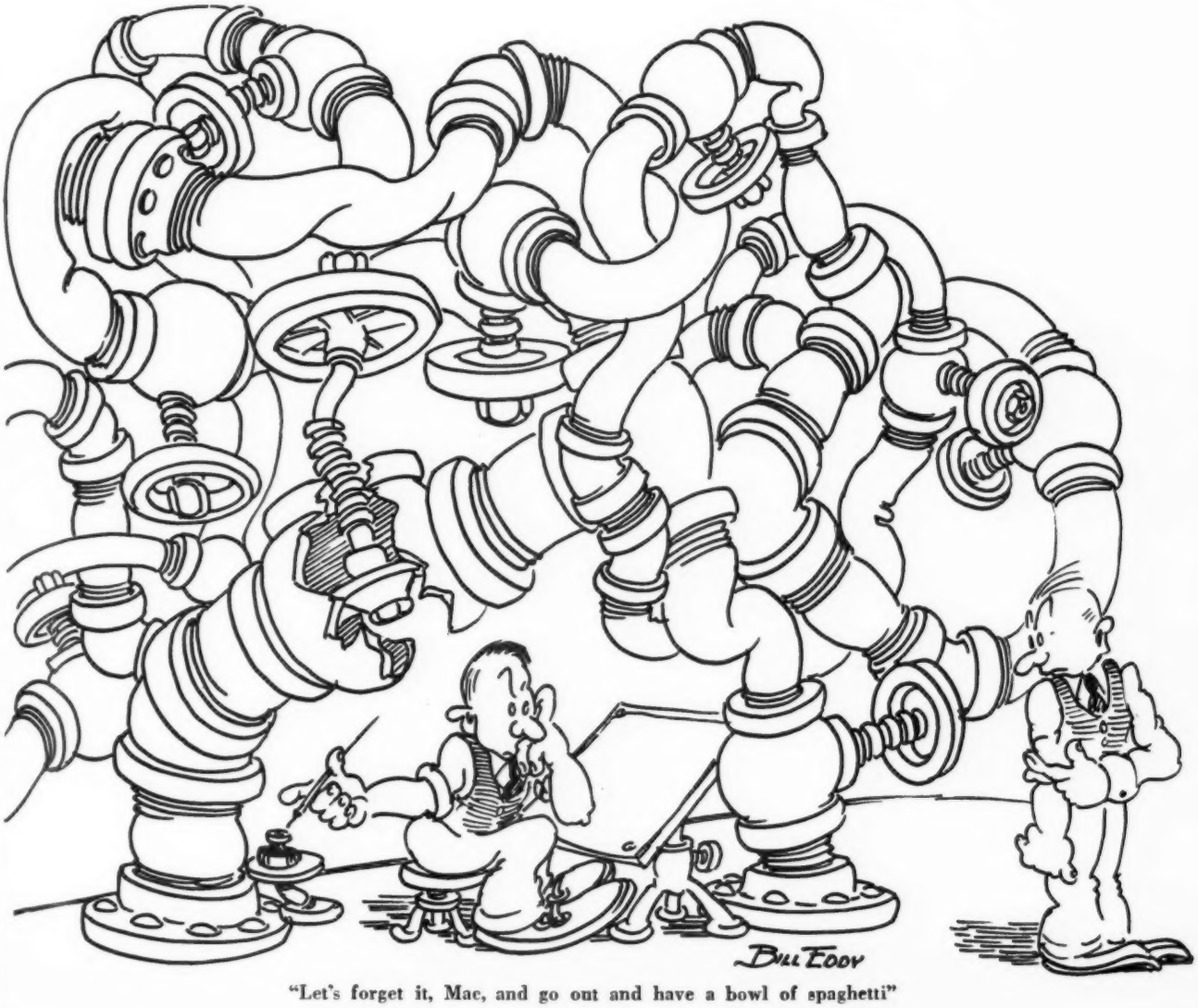

For horizontal drives
Straight-edge in contact with the large sprocket
Clamps for clamping straight-edge to the steel blocks
Cold rolled steel blocks clamped to the sprocket to support the straight-edge
Schematic elevation to show how straight-edge contacts one sprocket only

The desired alignment may be obtained by turning one of the shafts until the indicator reads the same in both positions. The procedure for vertical drives or those approaching a vertical position is done similarly, as shown in the sketch on page 116.

In principle a roller chain works well only as long as the pitch of the chain is the same as the chordal pitch of the sprocket. To make any allowance for tooth wear, to prevent riding or jumping of the chain, would be contrary to this principle. When the pitch of a roller chain increases because of wear, the chain can not seat itself on the root circle of the sprocket but only higher up on the teeth faces. This causes jumping and riding of the chain and excessive wear of the sprocket teeth with hook-shaped teeth resulting.

Silent chains have the feature of adjusting themselves for any difference in pitch between the chain and sprocket. Any difference in pitch is eliminated by the chain shifting radialy outward upon the sprocket teeth. Although in principle a worn silent chain works well to the point of disengagement from the sprocket teeth under the strain of load, it is not recommended to have the chain running too near the tops of the sprocket teeth, because the small area of contact between the chain and the sprocket teeth hastens the wear of the latter and means a loss of durability and reliability of the drive.

Philadelphia, Pa. EMIL WITTMANN



"Let's forget it, Mac, and go out and have a bowl of spaghetti"

Q&A — QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

2 —Boilers: Safety, Definitions, Firetube Types

Second in a series that is running in every number of POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment—its construction, principle, maintenance, efficiency and safe operation. In outstanding fashion he drills the young power engineer, polishes up the knowledge of the old-timer, helps all comers to pass engineer examinations and win certificates of higher grade.—Editor*

Safety Methods

Q 1—What are the objects of the various boiler acts and regulations?

A—Main objects are public safety and efficiency. Principal means of securing these are: (a) Setting up high standards for materials, design and workmanship in the construction of steam boilers and pressure vessels to insure strength, durability and safety. (b) Provision for periodic inspection of boilers and pressure vessels by qualified inspectors appointed for that purpose. (c) Certification of properly qualified engineers to have charge of and operate steam power, process and heating plants.

Q 2—How would you get a boiler ready for inspection?

A—Cool the boiler slowly. When it is cool, open the blowoff valve and drain the boiler. At the same time, open some small valve such as a try cock to permit air to enter the boiler as it drains and to prevent formation of a vacuum. When boiler is drained, wash out the interior and remove any loose scale and mud. Clean soot from outside of tubes and shell, and inside of firebox. Remove all soot and ashes from ashpit and combustion chamber. Have ready all tools, clamps and fittings that may be needed for valve or gage setting or testing. If the boiler is in battery with others, make sure that steam, water and blowoff valves cannot be accidentally opened while men are working in the empty boiler.

Q 3—How would you assist the boiler inspector during his inspection?

A—Give him all the help he needs in making his inspection. Point out any known defects. Station someone immediately outside the boiler when he is making his internal inspection; make

(*Continued on page* 120)

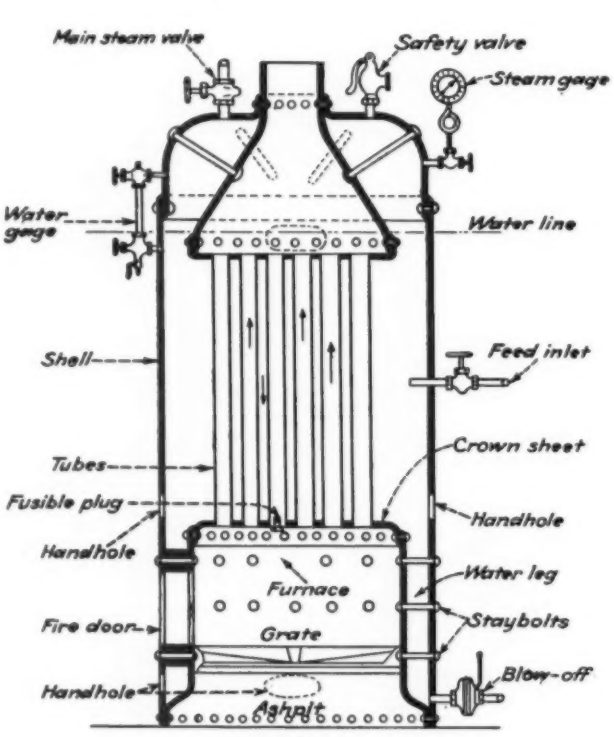


FIG. 1

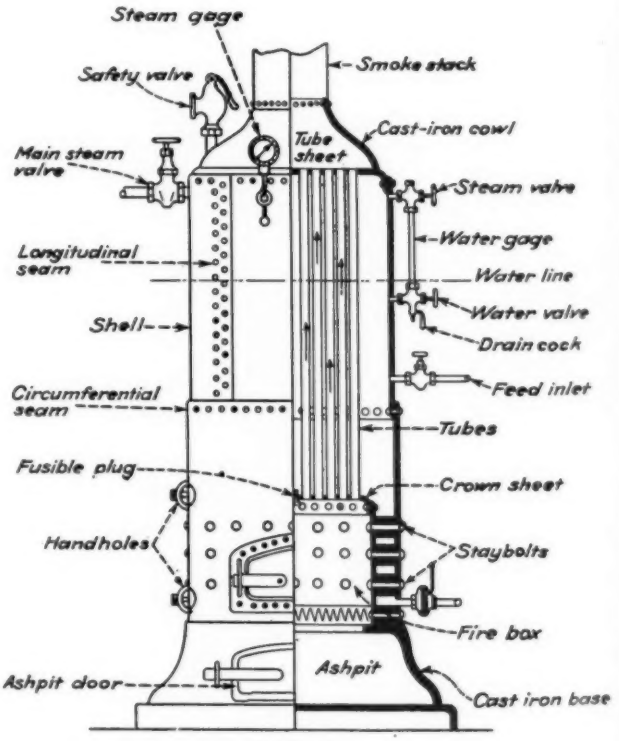


FIG. 2

Wet-top vertical boiler (Fig. 1) has water level above top tube sheet, dry top boiler (Fig. 2) below tube sheet

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(Continued from page 118)

sure, if the boiler is in battery with others, that all steam, water and blow-off valves are locked shut or otherwise secured so that they cannot be accidentally opened. Make provision for the application of the hydrostatic test and in general assist in every way to make the boiler inspector's examination thorough and complete.

Q 4—What action would you take on discovering a defect in the boilers or engines under your charge?

A—If the defect is not serious and there are facilities in the plant or close at hand for repairing or renewing the defective part, I would carry out the necessary repair or replacement as part of my routine duty as engineer. But if the defect is serious, I would immediately cut the defective apparatus out of service and notify my employer and the nearest boiler inspector.

Q 5—What should be your first duty on taking over a shift?

A—My very first duty would be to check the water level in the boilers, or have the fireman check it under my direct supervision.

Q 6—After the water level in the boilers has been checked, what should be the next procedure?

A—Examine the log book for anything out of the ordinary routine on the previous shift, and for any instructions left for the oncoming shift. After water levels have been checked, a complete inspection should be made of the entire plant. Examine all lubricators and oil pumps to see that they are full and working properly. Feel accessible bearings for signs of excessive heating. Read all recording gages, meters and switchboard instruments and note any deviation from normal. Ascertain cause of unusual noises and remove or remedy it. Make this plant inspection immediately on taking over as the time to find trouble left over from the previous shift is at the start of a shift and not some hours later.

Q 7—What certificates should be displayed in the plant engine room?

A—Certificates of the engineers operating the plant, boiler and pressure vessel inspection certificates, and any others that may be required by local authorities.

Boiler Definitions

Q 8—What is a steam boiler?

A—It is a closed vessel, strongly constructed of steel or iron. When in use it is partly filled with water, which is converted into steam by the external application of heat. The steam thus generated is used for power, heating or manufacturing.

Q 9—What is meant by steam space in connection with steam boilers?

A—A steam boiler is only partly filled with water when in operation. Remaining space is called steam space because it is needed for the disengagement of steam from the water and for storage of this steam until it is drawn off through the steam main.

Q 10—What constitutes the heating surface of a steam boiler?

A—The heating surface consists of all parts of the boiler that have water on one side and fire or hot gases on the other. When the boiler is fired there is a continual transfer of heat from the fire or hot gases on the one side through the plate to the water on the other side.

Q 11—What is grate surface?

A—This is the area of the grate upon which fire rests in a coal or wood-fired boiler. It is usually measured in square feet. Thus the area of a fire grate 6 ft long by 5 ft wide would be 6 x 5=30 sq ft.

Q 12—In connection with steam boilers what is meant by (a) water line? (b) fire line?

A—(a) Water line is the level at which water stands. To prevent burning plates or tubes, this level should always be higher than the highest point of the heating surface. (b) Fire line is the highest point of the heating surface.

Q 13—Name some of the requirements of a good type of steam boiler.

A—(a) Strong and simple construction. (b) Materials and workmanship of highest standard. (c) Design that insures constant circulation of water in boiler, thus distributing heat evenly through the entire body of water and keeping the various parts of heating surface as nearly as possible at the same temperature. (d) Large area of heating surface to insure the utmost possible transfer of heat from the hot gases in the furnace to the water in the boiler. (e) All parts of boiler readily accessible for repair, inspection and cleaning. (f) Ample combustion space so that gases will be completely burned before passing to the chimney. (g) Large steam space so that steam is able to rise freely from surface of water.

Q 14—How are boilers classified?

A—Boilers may be classified in the following ways: (a) according to direction of axis of shell, *vertical* or *horizontal;* (b) according to use to which they are put, *stationary, portable, tractor* or *marine;* (c) according to location of furnace, *internally fired* or *externally fired;* (d) according to relative positions of water and hot gases, *watertube* or *firetube.*

Q 15—Describe the horizontal-return-tubular boiler according to classifica-

(Continued on page 122)

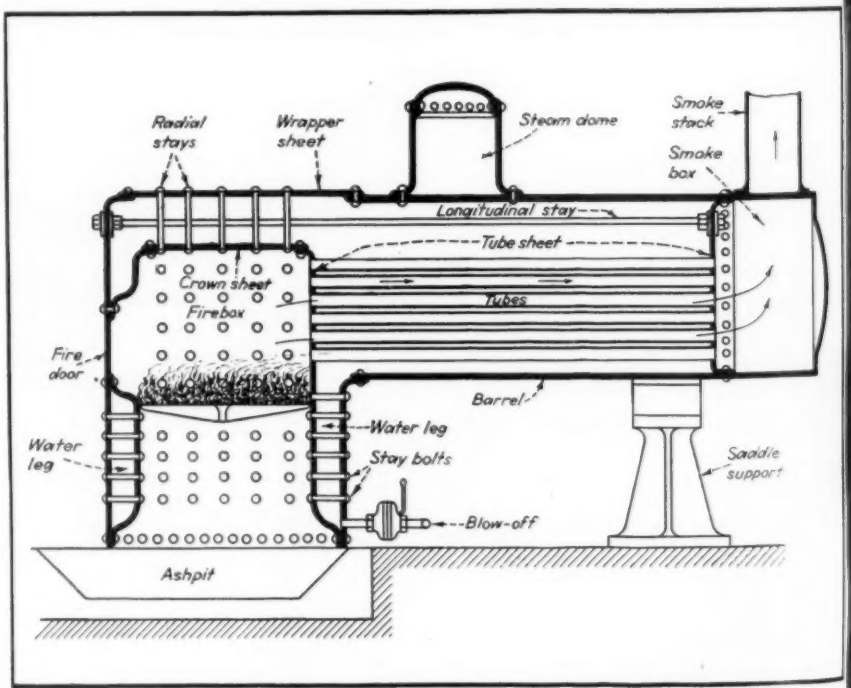

Fig. 3 — Locomotive-type stationary boiler. Note required staybolts and stays

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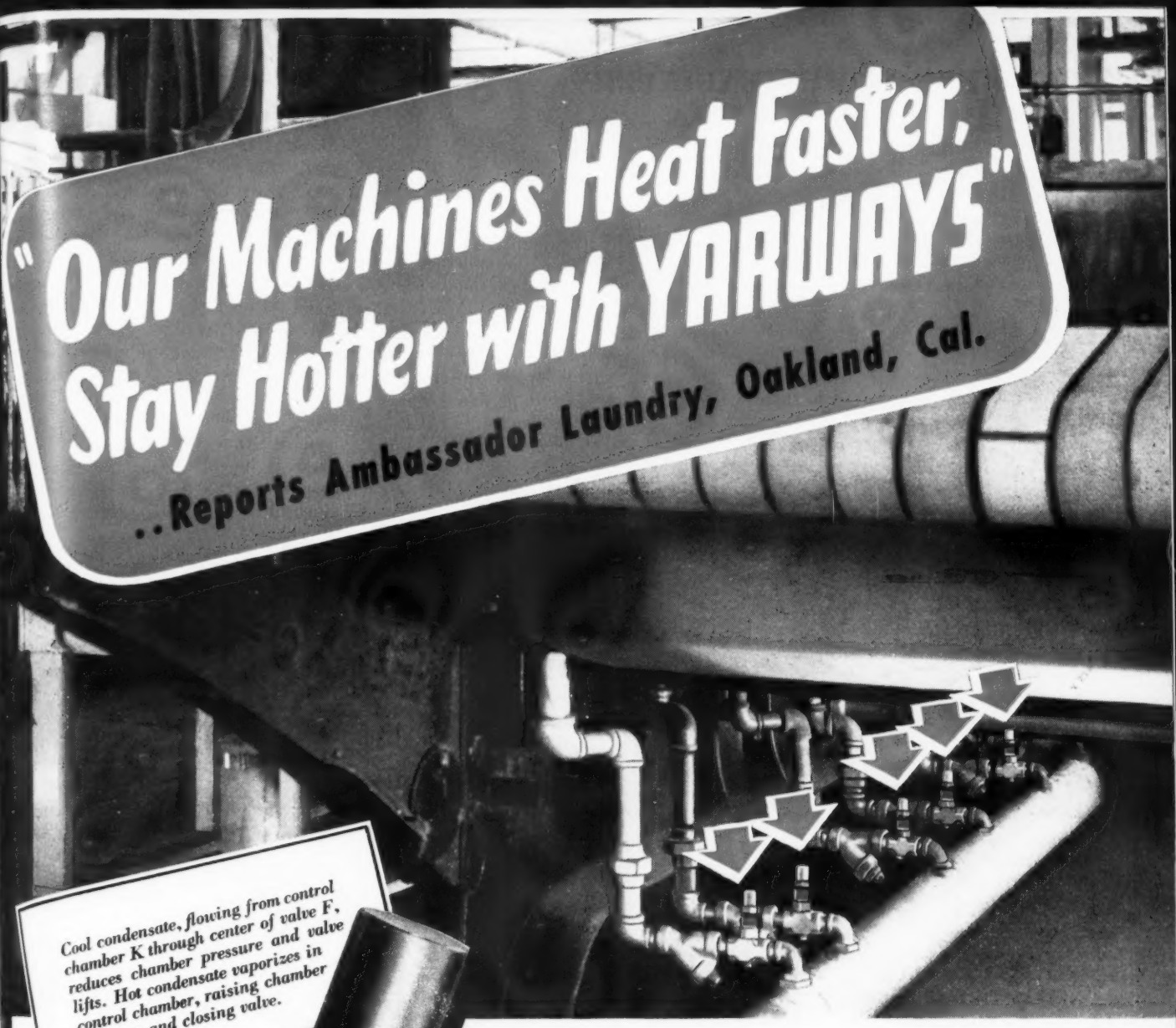

Cool condensate, flowing from control chamber K through center of valve F, reduces chamber pressure and valve lifts. Hot condensate vaporizes in control chamber, raising chamber pressure and closing valve.

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YARWAY IMPULSE STEAM TRAP

Q&A FOR POWER ENGINEERS

(*Continued from page* 120)

tions in preceding question:

A—Horizontal-return-tubular boiler, Fig. 5, commonly called hrt, is a horizontal, stationary, externally fired, firetube boiler.

Q 16—What is the difference between a tube and a flue?

A—Both are cylindrical tubes but the term, tube, is usually applied to those of small diameter, up to about 6 in. Over this diameter, they are called flues. Note that tube sizes refer to *outside* diameters.

Q 17—What is the difference between a firetube and a watertube?

A—A firetube has water on the outside of the tube, while fire or hot gases pass inside the tube. A watertube has the opposite condition: water passes through the inside and fire or hot gases are on the outside.

Firetube Types

Q 18—Describe the vertical dry-top boiler.

A—This is a vertical, internally fired, firetube, portable boiler, Fig. 2, consisting of a vertical, cylindrical shell containing a firebox and a number of small fire tubes. Heat radiated from the fire passes through the firebox plates to the water in the boiler. The hot gases pass upward through the fire tubes to the smoke stack, giving up part of their heat to the metal of the tubes, which in turn transfer heat to the boiler water.

The upper tube plate forms the top head of the boiler. As the water level is carried about two-thirds of the length of the tubes above the lower tube sheet, or crown sheet, the top tube sheet is dry, that is, it has steam on one side and hot gases on the other. Hence the name *dry top.* Main defect in this form of construction is the danger of the firetubes becoming loose from overheating in the upper tube sheet.

Handholes and clean-out plugs are provided in the shell at convenient points for washing out and inspection. Bottom of shell rests on a cast-iron base that also forms the ashpit. This type of boiler is used principally for portable machinery or in small stationary plants. It is seldom made in sizes over 50 hp (that is, 500 sq ft of heating surface) or for pressures exceeding 100 psi.

Q 19—Describe the vertical, wet-top or submerged-top boiler.

A—This boiler, Fig. 1, is similar in construction to the dry-top vertical except for the top head. In the wet-top boiler, a conical-shaped plate is riveted to the top head and the upper tube sheet forms the bottom of this cone. This enables the water line to be carried above the upper tube sheet so that it and all the tubes are below the water level. Hence the name, *submerged-top* or *wet-top* boiler. Other construction details are the same as in the dry-top boiler.

Q 20—What are the advantages and disadvantages of vertical firetube boilers?

A—Generally speaking, advantages are: (a) compactness and portability, (b) low first cost, (c) fairly rapid steamers, (d) no special setting required. Disadvantages are: (a) Interior is not readily accessible for cleaning, inspection or repair. (b) Water capacity is small, making it hard to keep a steady steam pressure under varying load. (c) Boiler is liable to prime (pull over water with steam) when under heavy load, as steam space is small. (d) Economy is low. Hot gases have a very short and direct path to the stack, and much of the heat in the fuel is lost up the chimney.

Q 21—Describe the locomotive-type boiler, and name all its parts.

A—This type, Fig. 3, is used on locomotives and steam tractors, also for portable and stationary work. Like the vertical-tubular, the locomotive-type boiler is an internally fired, firetube unit, but its *shell* is horizontal and the *firebox* is not contained within the cylindrical portion of the boiler. Firebox is rectangular in shape, with a curved top or *crownsheet.* This crownsheet is supported by *radial stays,* screwed into the crownsheet and the outer *wrapper sheet* and riveted over.

The *inner side sheets* of firebox are connected to the *outer side sheets* by short screwed stays called staybolts. Space between these sheets is called a *water leg.* The *firetubes* are within the barrel and run from the *firebox tube sheet* to the other head of the barrel, this head being in a *smoke box* formed by extending the barrel beyond the *tube sheet.*

The *firebox front sheet,* above the crownsheet, and *smoke box tube sheet,* above the tubes, are supported by *longitudinal stays.* In some cases *diagonal stays,* also, are used for this purpose. [Stays will be described in a later number of POWER.]

The *steam dome* provides additional steam storage space and allows the *main steam outlet* to be taken off at a considerable height above the water line, thus reducing liability of water being carried over with steam.

Q 22—What are the main characteristics of the locomotive boiler?

A—It is compact and portable, requires no elaborate setting, has a large heating surface, and is a fairly rapid steamer. On the other hand, it is hard to clean internally and is not economical of fuel because of the short gas travel

(*Continued on page* 124)

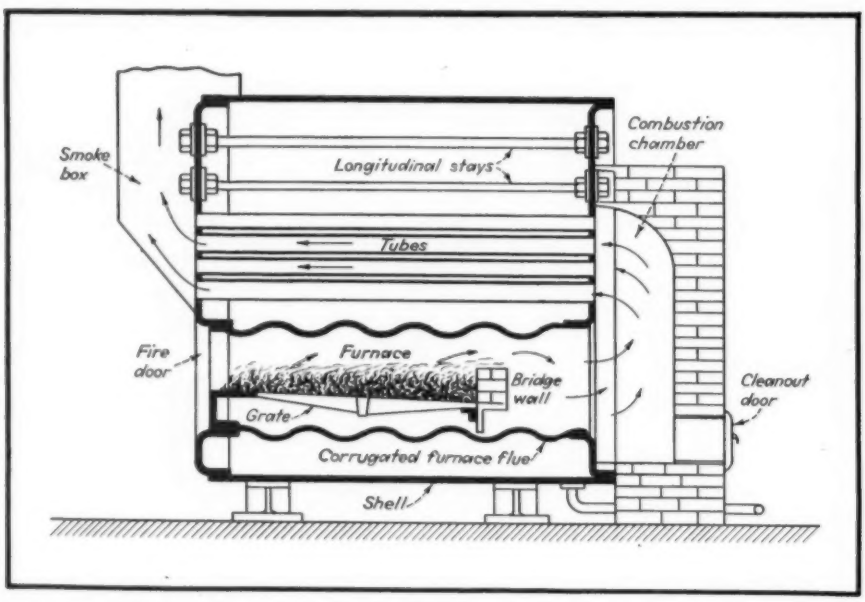
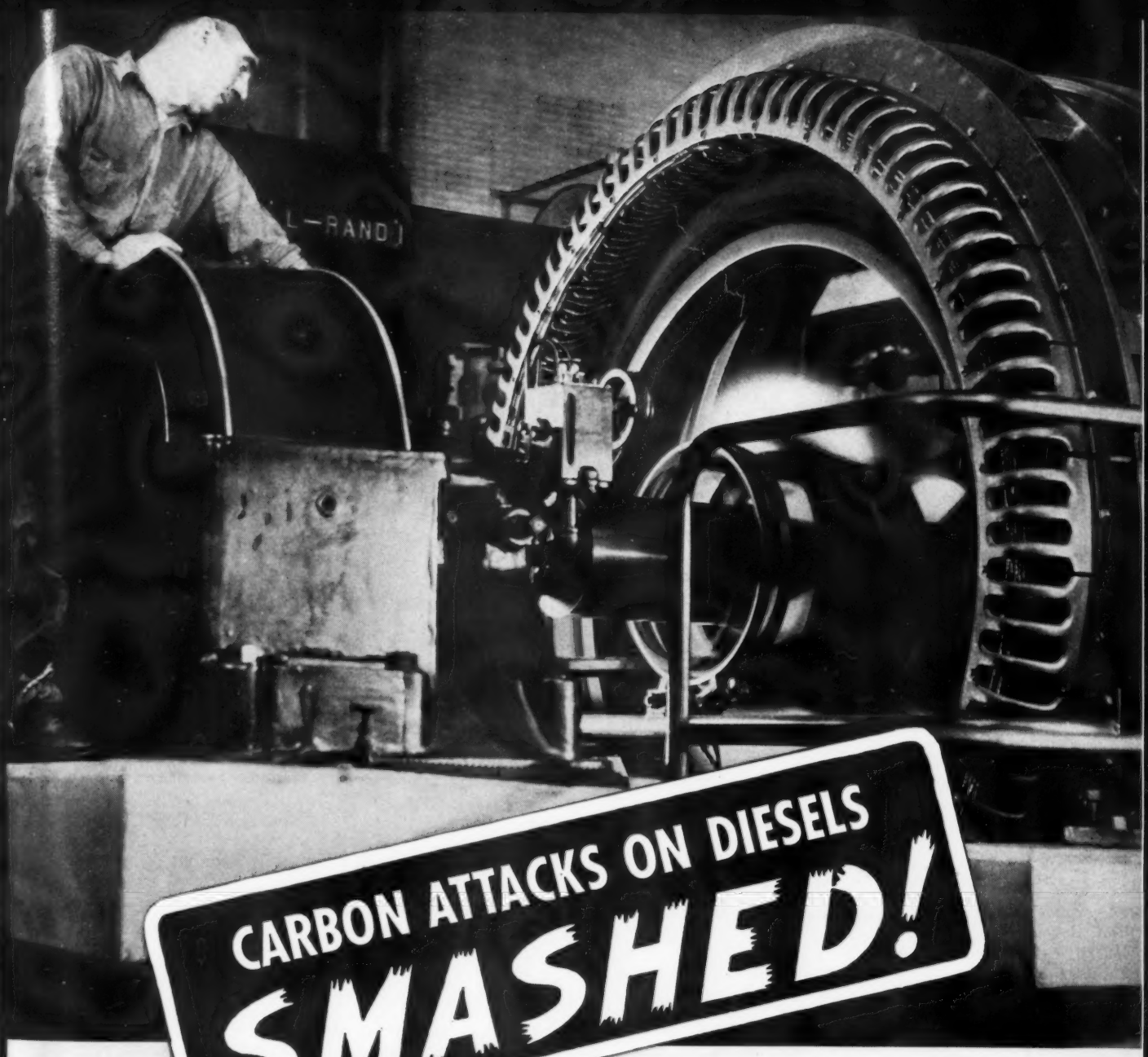


Fig. 4 — Dry-back marine-type boiler is a stationary plant modification of the wet-back Scotch marine. Note the corrugated pattern of the furnace flue.



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Q&A FOR POWER ENGINEERS

(*Continued from page 122*)

from the firebox to the chimney and the comparatively large amount of heat lost up the stack.

Q 23—Describe the dry-back marine-type boiler.

A—This boiler, Fig. 4, is an adaptation to stationary practice of the well-known Scotch-marine wet-back boiler. It consists of an outer cylindrical shell of short length but large diameter, containing usually two large furnace flues of corrugated pattern the better to withstand expansion and contraction stresses. The hot gases from these furnaces pass into a brick combustion chamber at the back of the boiler and return through the firetubes to the front of the boiler, and thence to the chimney.

In the wet-back marine boiler, the shell, tube and furnace construction are similar, but the combustion chamber is contained within the shell and no outside setting is required. The dry-back type is a quick steamer because of its large heating surface, is compact and easily set up and shows fairly good economy.

Q 24—Describe the horizontal-return-tubular (hrt) boiler.

A—This boiler, Fig. 5, is probably the most common form of externally fired firetube boiler and the most widely used boiler in small or medium-sized power plants. Unlike the vertical, tubular, locomotive or dry-back marine boilers, the hrt contains no firebox and must be externally fired. This makes a brick setting with steel columns and beams necessary to support the boiler and provide furnace and combustion space. The boiler itself is a cylindrical shell with flat ends or heads and contains a large number of fire tubes.

The grates are beneath the front part of the boiler shell. The hot gases from the furnace pass along the bottom of the shell to the rear, returning through the firetubes to the smoke box at the front and thence to the stack. This *return* tube arrangement gives the hot gases a much longer travel than they have in the *direct* tube arrangement of the vertical, tubular or locomotive boilers, where they pass directly from the fire through the tubes to the chimney.

Q 25—What are the advantages and disadvantages of the hrt boiler?

A—It is simple in construction, has a fairly low first cost and is a good steamer. It is more economical than the vertical tubular or locomotive types and hence more suitable for medium-sized stationary plants. On the other hand, it is difficult to remove hard deposits of scale from the surfaces of the inner rows of tubes, and there is great danger of burning the shell plates above the fire if thick scale or deposits of mud form on these plates. This difficulty in cleaning scale from the tubes is also encountered in the other types of firetube boilers.

Q 26—Why isn't the hrt boiler built in larger sizes?

A—It is inadvisable to build hrt boilers larger than 78-in. diameter shell or for higher pressures than 150 psi because they would require much thicker shell plates. Thick plates exposed directly to intense heat deteriorate very rapidly from overheating.

NEXT MONTH

The third installment of Mr Higgins' "Q and A" will ask and answer practical questions regarding common types of watertube boilers and show how to figure boiler heating surface.

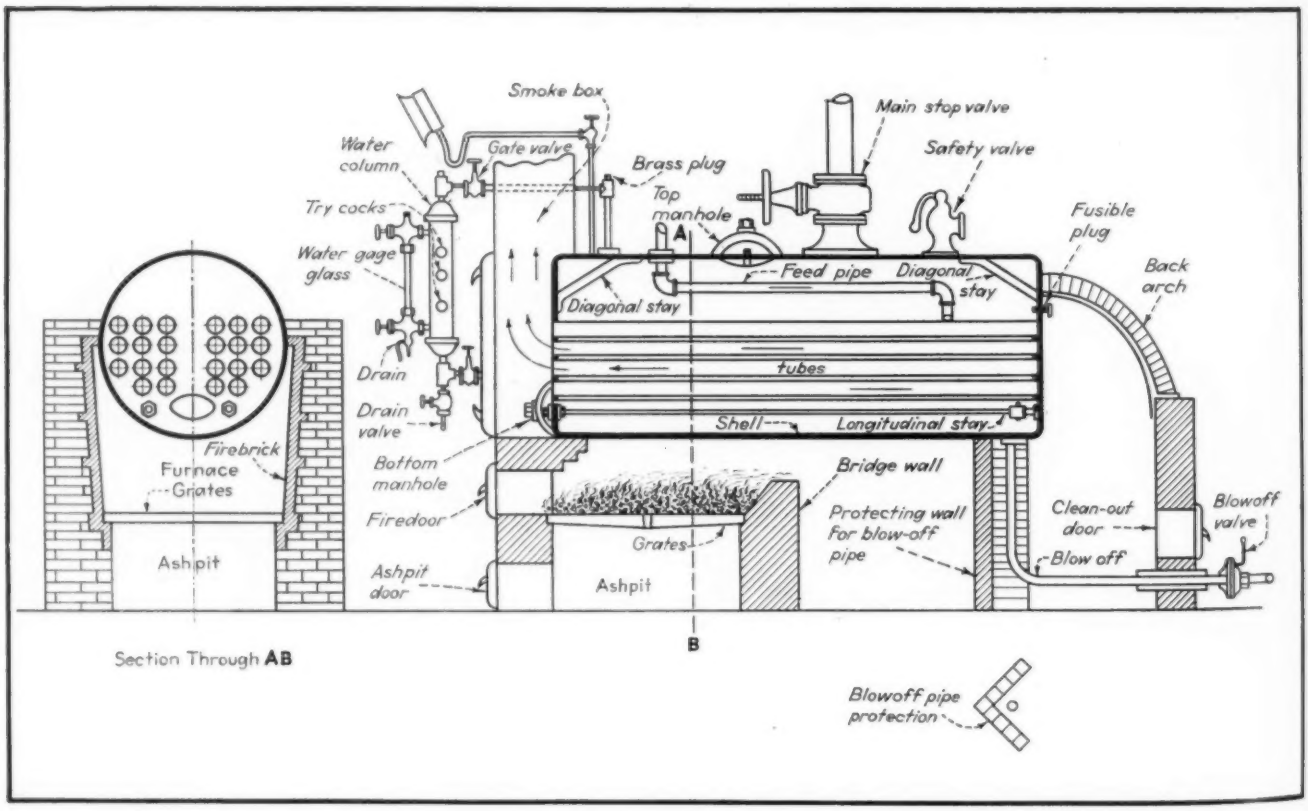
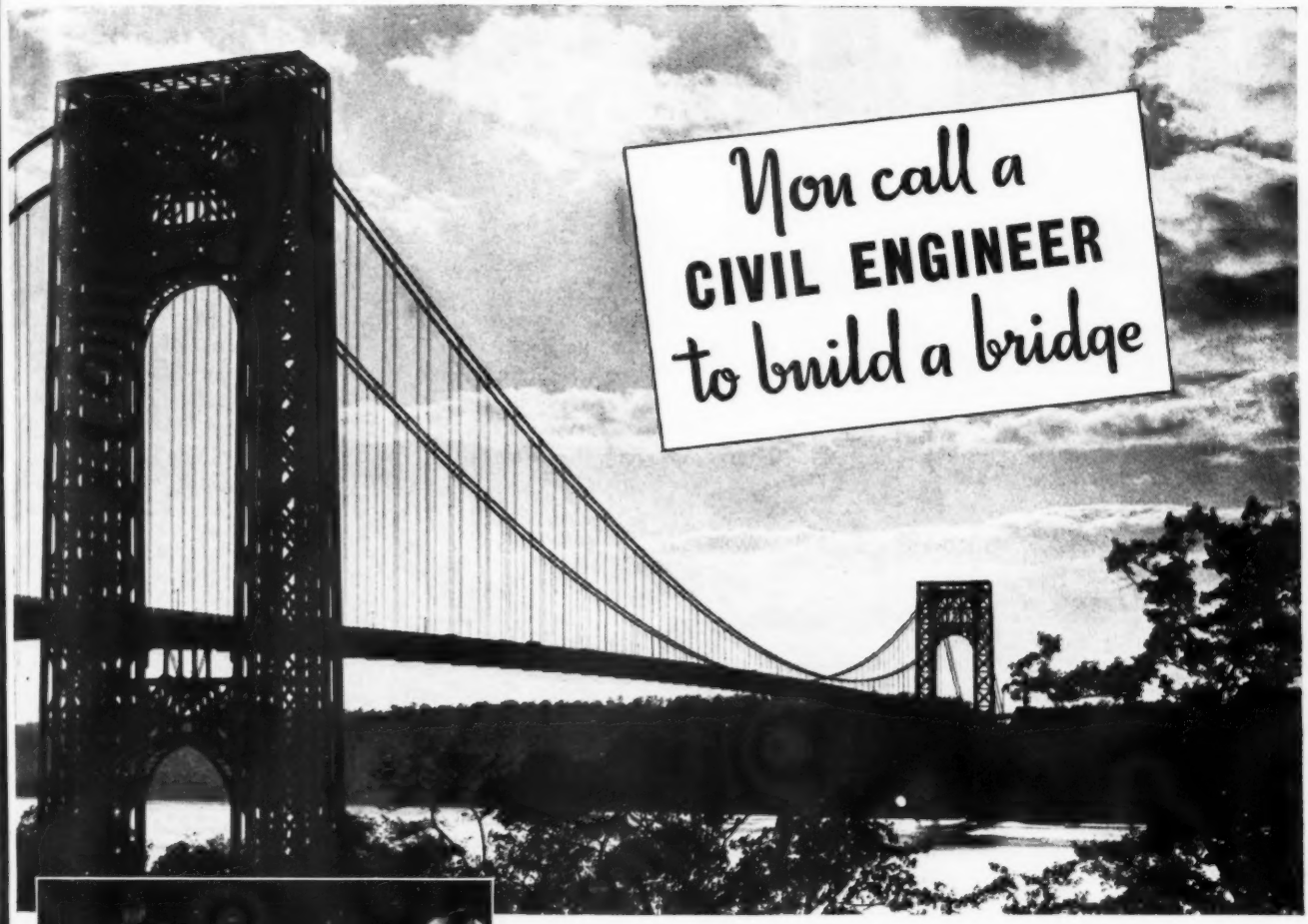
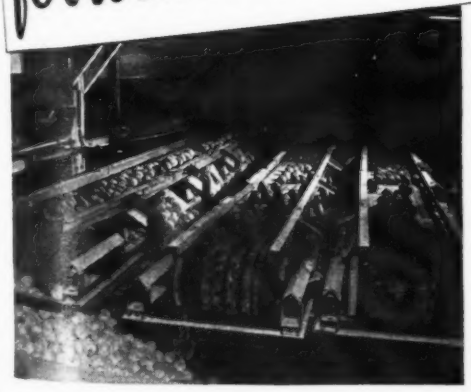


Fig. 5 — The horizontal-return-tubular boiler (commonly called hrt) is a widely used type of firetube boiler



You call a CIVIL ENGINEER to build a bridge

call the NALCO MAN for water treatment



EVERY man to his calling—the jack-of-all-trades and master of none is singing his swan song these days. In everything from building bridges to water treatment, you want the man who *knows his job.* Water treatment is so vast a subject, research in it has reached such a fine degree that only a few individuals have emerged who are true authorities on the subject. You'll find such men at Nalco working in one of the finest water treatment laboratories in the world. These men can end *permanently* your water treatment problems. No matter what your needs, it will pay you to call the *Nalco Man—today.*

NATIONAL ALUMINATE CORPORATION

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Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

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nalco

HOW TO LEARN BASIC PIPE WELDING

EDITOR'S NOTE

The "know how" of pipe welding should be in every power-plant engineer's mental tool kit. However, many engineers and maintenance men have never made a thorough study of pipe-welding methods. Others are expert themselves but want to train new men. To meet these needs, POWER *has secured permission from Linde Air Products Co to publish a condensed but essentially complete version of their excellent study course on pipe welding, originally published in* Oxy-Acetylene Tips. *We have divided this study material in such a manner that each month's instruction sheet will be complete in itself, covering one part of the pipe-welding art.*

THESE STUDY SHEETS are intended to outline, for the beginner, the basic methods of welding pipe. They assume that the student has had no pipe-welding experience but that he does know how to use oxyacetylene welding equipment to make simple welds in steel. Beginning with data on methods of preparing pipe for welding, the series will cover rolling, horizontal, and position welds.

Each of the basic welding operations shown in the study sheets is set up in the form of a practice exercise. For this purpose, use standard steel pipe, commonly called black iron pipe, which is made from low-carbon steel and offers good weldability.

To carry out the exercises will require (1) a supply of oxygen and acetylene, (2) welding outfit with cutting attachment, goggles, gloves, (3) 2 lb of 1/8-in. welding rod, (4) 4 lb of 1/4-in. welding rod, (5) pair of tongs, (6) two firebricks, (7) several C-clamps, (8) a 3-in. channel about 18 in. long, (9) a 2-in. angle about 18 in. long, (10) a 3/4x2-in. bar about 2 ft long, (11) 6 pieces 1/4-in. steel plate, 6 in. square, (12) an assortment of short lengths of pipe as follows:

Number of pieces	Diameter, in.	Length, in.
2	1	3
6	2	6
1	3	6
6	6	6
3	6	10
4	8	4

Preparing Pipe for Welding

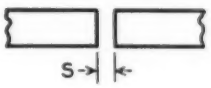
1 Most pipes are joined by butt welding. For such a joint, the pipe ends must be beveled whenever the metal is more than 3/16 in. thick, to make sure that the weld will go clear through to the inside wall of the pipe. For wall thicknesses less than 3/16 in. pipe may be cut square. The sketches and table at the right show recommended joint preparation for butt-welding standard steel pipe. In this pipe weight, beveling is required for 2½-in. or bigger pipe. It is customary to bevel 2-in. pipe only if pressure is to be high or if a joint of maximum strength is demanded.

Note that the sketches show two kinds of beveling. The simpler of the two (above) should be used for practice welds. The bevel with a shoulder at the root of the weld, (below) conforms to the requirements of the AWS (American Welding Society) Standard Qualification Procedure for 3/8-in.-thick test specimens, used for qualifying operators to weld pipe having wall thicknesses up to and including 3/4 in. With this design, pipe must first be cut square and then beveled, or beveled all the way through and then the shoulder flame-cut, filed, or ground after beveling. The spacing for qualification-test welds is usually made slightly wider than for plain beveled joints.

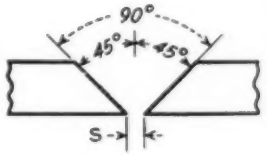
The required short lengths of pipe listed above can be cut (1) in a lathe or with a hacksaw, (2) with a pipecutter, which produces a slight bevel that is advantageous, or (3) preferably with a blowpipe—either freehand or with the aid of a suitable mechanical device

JOINT PREPARATION FOR BUTT-WELDING STANDARD PIPE

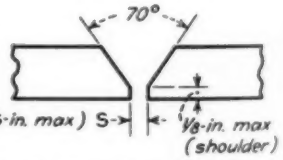
A—For pipe up to 2½ in. in diameter



B—For pipe 2½ in. in diameter and up; practice welds



C—For pipe 2½ in. in diameter and up; qualification welds



Recommended Spacing Between Pipe Ends, "S" (before tack-welding)

Nominal diameter, in.	Beveled single vee 90-deg incl angle, in.	Not beveled, in.
3/4 to 1 1/4	—	3/32
1½	—	1/8
2 to 2½	3/32	1/8
3 to 8	3/16	—
8 to 12	1/8	—

PACKING

Edward processed rings of EValpak (graphited asbestos, wire inserted type) for severe pressure and temperature service.

STEMS

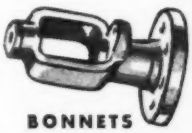
Heat treated and ground EValloy, Edward's highly heat resistant stainless steel, with Acme form threads.

DISKS

Carbon-molybdenum alloy steel with heavy layer of ground and lapped Stellite. Designed to prevent spinning in service.

HANDWHEELS

Strong, malleable iron, with over-size dimensions and knobbed for easy grip and quick operation.

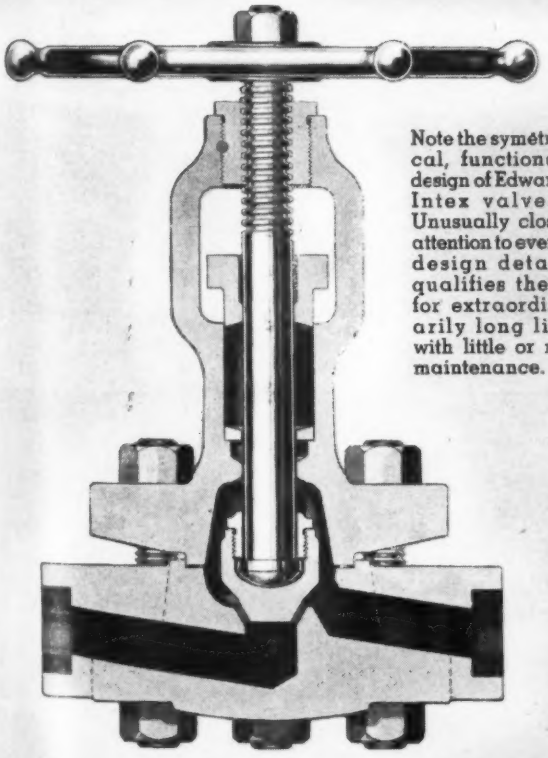


BONNETS

Carbon-molybdenum steel with replaceable bronze yoke bushing. Extra deep stuffing box and condensing chamber lengthens packing life.

BODIES

Weldable carbon-molybdenum steel with flanged, screwed or socket welding ends. Integral, erosion-resistant Stellite seat with wide contact face.



Note the symetrical, functional design of Edward Intex valves. Unusually close attention to every design detail qualifies them for extraordinarily long life with little or no maintenance.

EDWARD INTEX* VALVES FOR TOUGH WAR JOBS

If you're looking for a valve that will stand up on the *really tough* war jobs where piping systems are operating at temperature and pressure extremes, here's the answer.

Edward Intex globe stop valves, built for service to 1500 lb at 950 F, include such wear-fighting features as integral seats of Stellite, balanced disks which are also generously faced with erosion-resistant Stellite, and carefully contoured bodies that eliminate distortion in heating and cooling.

You gain this way, too ... Because Edward Intex valves are so widely used and are being manufactured in production-run quantities, delivery schedules are better than you usually expect these days. If you want the whole story on Edward Intex valves, write today for Catalog 12-G5.

* *Integral Seat Valves of Extra Value*

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EDWARD *Steel* VALVES
CAST AND FORGED

HOW TO LEARN BASIC PIPE WELDING

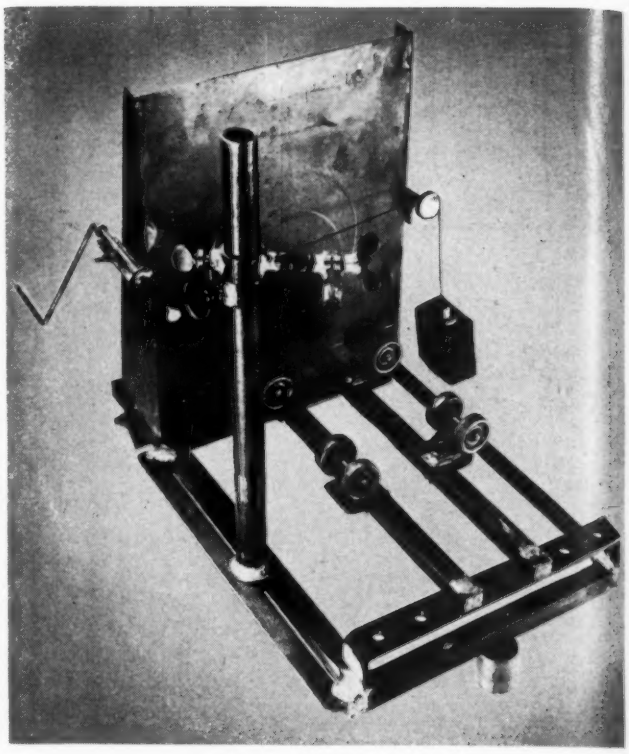
Continued from page 126

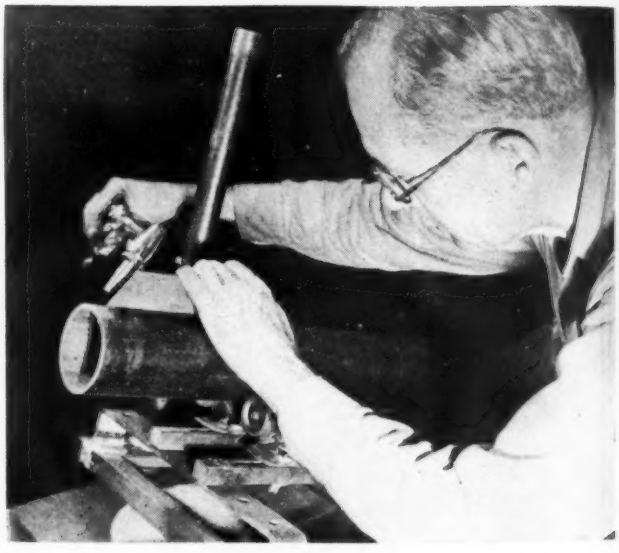
2 A homemade jig such as that shown at the right is useful for the class of work included in these study sheets. The general principles can be applied to larger cutting jigs better suited to all-round work in the plant.

The rollers, salvaged from a pair of old roller skates, fasten, with wing nuts, to slotted bars fitted with a pin at each end. Slots permit rollers to be moved back and forth on the bar. By fitting the pins in holes in the cross bar at the front and the faceplate at the rear, the bars carrying the rollers can be moved farther apart or closer together.

A short vertical length of pipe, welded to the base, supports an adjustable clamp to hold the cutting torch. A crank made of welding rod mounts at one side of the faceplate and an idler pulley at the other. With a stout cord and a weight, these form the mechanism for rotating the pipe during the cutting operation.

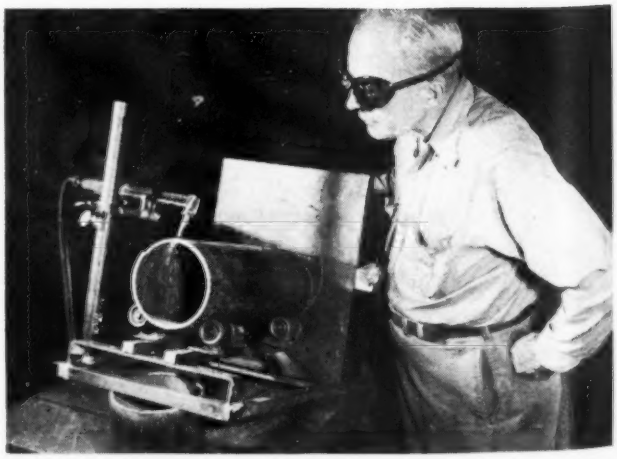
To use the jig, mount the pipe on the rollers and take a turn about the back end with the cord. Attach one end of the cord to the crank and pass the other end over the idler pulley, attaching a weight to keep the cord taut. Adjust height of crank and idler so that they are slightly lower than the top of the pipe. This gives a better grip on the pipe and avoids any tendency to lift pipe off rollers





3 Mount the blowpipe head in the clamp and adjust the head to an angle of 45 deg. A gage, accurately cut from 16-gage sheet metal, proves a big help in setting the blowpipe angle. An assortment of such gages permits cutting pipes either straight or at any desired angle by merely adjusting the angle of the blowpipe head.

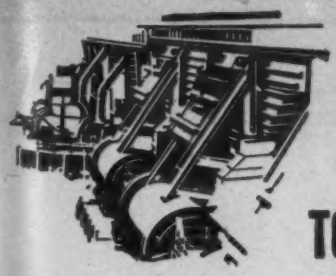
Light the blowpipe and adjust the flame. Then swing the blowpipe toward the end of the pipe until the preheating flames just touch the edge



4 As soon as a small area of metal is red hot, open the cutting-oxygen valve and swing the blowpipe into the line of cut. At the same time start turning the crank, thus rolling the pipe. You will soon be able to judge the correct speed and hold it through the cutting operation.

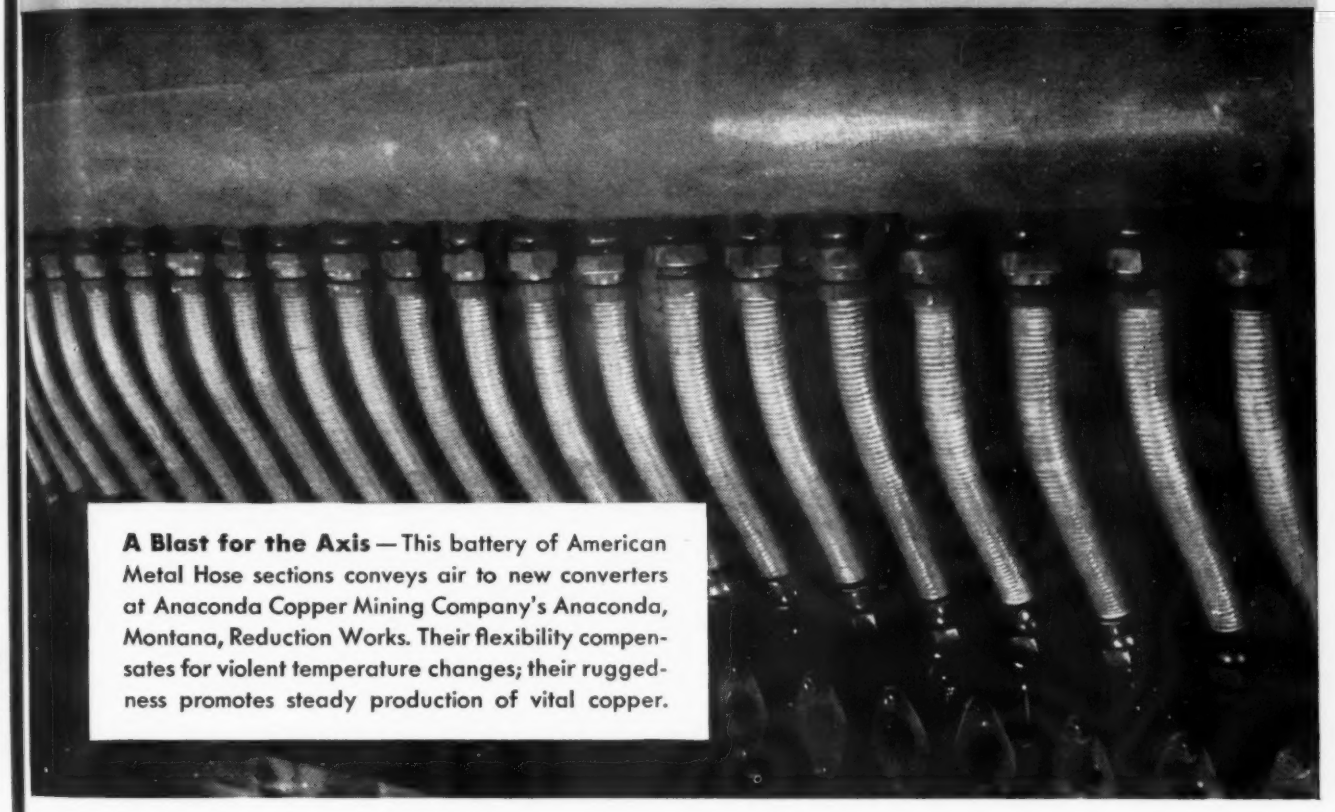
If the rig is tilted slightly by propping up the forward end, gravity will keep the far end of the pipe against the faceplate. With reasonable care, smooth, even cuts can be made with this setup.

After a pipe has been cut, whether straight or beveled, clean off the oxide with a file or hammer and chisel



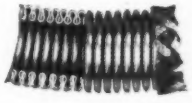
Hose that conveys cold air under 15 lbs. pressure

TO FURNACES HOLDING TONS OF MOLTEN COPPER



A Blast for the Axis—This battery of American Metal Hose sections conveys air to new converters at Anaconda Copper Mining Company's Anaconda, Montana, Reduction Works. Their flexibility compensates for violent temperature changes; their ruggedness promotes steady production of vital copper.

One of the most attractive features of flexible metal hose and tubing is its seemingly endless range of application. Using virtually any work-



American Seamless — corrugated from seamless rigid tubing . . . no welds, laps or joints . . . made in several alloys.

able metal, we can build flexible hose or tubing for almost any purpose—from a simple spout to a high pressure seamless hydraulic line that can be flexed millions of times without breaking—a line that will give you the flexibility of garden hose, the dependability of metal and the *strength of rigid pipe!*

Whether you need a flexible connector for misaligned or moving parts, for isolating vibration, for conveying air, water, oil, steam or fuel,

American Interlocked —wound of strip metal, joints packed; the toughest type of extremely flexible metal hose.

you'll likely find we have a type of flexible metal hose or tubing that will do the job more capably.

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American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury, Conn.
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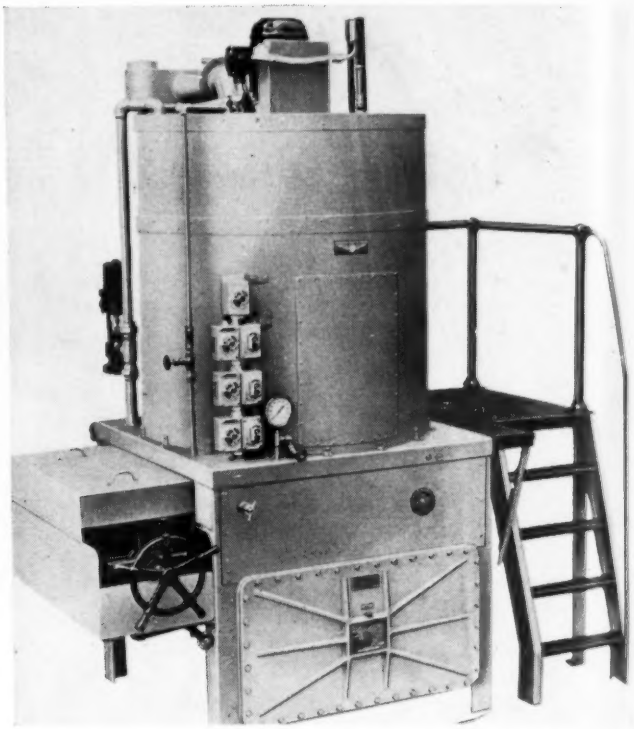
WHAT'S NEW IN PLANT EQUIPMENT



Portable Electric Drill

THOR PLASTIC 1/4-IN. PORTABLE ELECTRIC DRILL made available to all war industries recently. The grip handle, field case and gear case of drill are constructed of new lightweight plastic, Thorite, developed for company. Drill is said to be strong, shock proof, compact, light, and cool to handle. *Independent Pneumatic Tool Co, 600 West Jackson Blvd, Chicago, Ill.*

Automatic Transfer Switch

SIMPLICITY, a minimum of parts, and an advance in dependable automatic efficiency are outstanding characteristics of improved automatic transfer switch. Unit is so designed that all contacts are carried on one shaft and operate in the same direction. Arrangement is such that all times the contacts are either in normal or emergency position. One magnet frame with the coil connected to normal supply line holds normal contacts closed and emergency contacts open during normal operation. On failure of normal service normal contacts open by gravity and the emergency contacts close by means of individual compression springs on each contact. On resumption of normal service the magnet closes normal contacts and opens other supply sources. The switch can be set for timed automatic supply when that is desired. *Zenith Electric Co, 152 W Walton Street, Chicago, Ill.*

Condensate-Return Units

SERIES G UNITS conform to War Department Chief of Engineers Specifications No. 8672-E Revised. They are compact in design, use a minimum of critical materials and can be used for a variety of condensate-return requirements. Units are completely prefabricated with all interconnecting piping and wiring installed, ready to plug in. Some units are carried in stock for immediate shipment. These systems can be currently purchased on a priority as low as A-1-C (as of February 1, 1943). *Fred H Schaub Engineering Co, Inc, 325 W Huron St, Chicago, Ill.*

Oil Reclaimer

NEW MODEL OIL RECLAIMER has capacity of 200 gallons of dirty oil in 90 minutes. Unit is said to restore used oil to new oil values of viscosity, fire and flash, neutralization number and color. Company also builds reclaimers in several smaller capacities for industrial users, including diesel-engine builders. Equipment may also be used for salvaging transformer oils. *Youngstown Miller Co, Sandusky, Ohio.*

Flush Valves

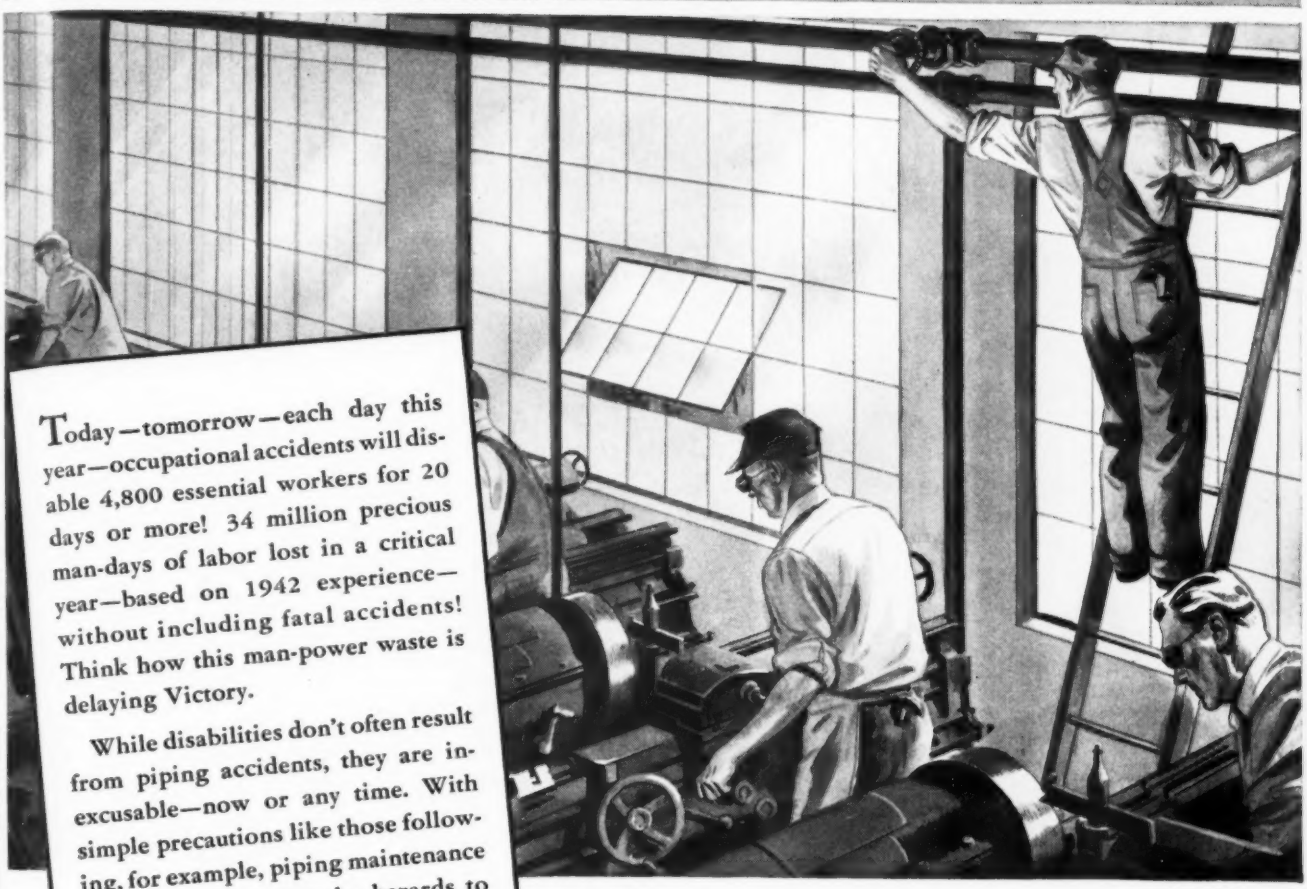
"V" MODEL WATROUS FLUSH VALVE conserves critical war materials such as brass and copper, conforms to material conservation requirements of War Department Specification PE-623, it is stated, and are approved for use on government projects. Can be furnished for essential wartime construction having proper priority and end-use ratings. "V" model retains proved design features of the Watrous "Jewel" flush valve, and is essentially same in appearance. *Imperial Brass Mfg Co, 1200 W Harrison St, Chicago, Ill.*

Wood Link Matting

FLEXIBLE WOOD LINK matting substantially constructed of wood links. Light

(*Continued on page* 150)

4800 WORKERS WILL BE HURT TODAY



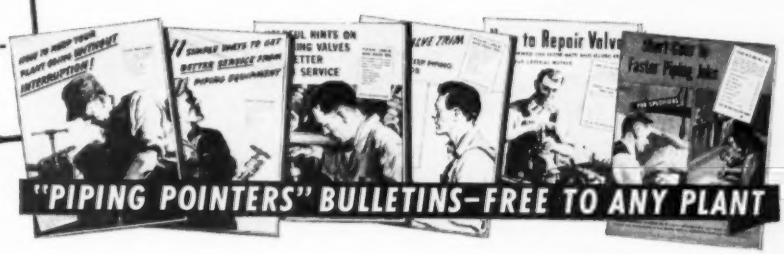
Today—tomorrow—each day this year—occupational accidents will disable 4,800 essential workers for 20 days or more! 34 million precious man-days of labor lost in a critical year—based on 1942 experience—without including fatal accidents! Think how this man-power waste is delaying Victory.

While disabilities don't often result from piping accidents, they are inexcusable—now or any time. With simple precautions like those following, for example, piping maintenance men can help lessen the hazards to American workers now when they're most needed on the job.

SAFETY HINTS FOR PIPING MEN

1. *Don't install valves where getting at them means exposure to danger.*
2. *Support lines firmly to prevent loosening at joints.*
3. *Identify valves so they can be quickly operated in emergencies.*
4. *Install relief valves where there is danger of sudden built-up pressures.*
5. *Inspect sprinkler system control valves regularly. Keep them open always.*

The safety hints given here are from "Piping Pointers" Bulletins—a Crane service aiding piping men in hundreds of plants in doing more to help win the war. Giving many "*do's and don'ts*" and "*rights and wrongs*" on keeping pipe lines at peak efficiency—conserving critical metals—and speeding piping jobs, these bulletins, based on Crane's 87-year leadership in flow-control engineering, are especially valuable for training new maintenance men. Copies free on request from your Crane Representative or by writing to: Crane Co., 836 South Michigan Avenue, Chicago, Illinois.



ARMY E NAVY

CRANE VALVES

Job For Management . . .

A fellow I know, who is a department superintendent in an aircraft plant, started to talk to me about the problem of absenteeism (by which he means needless absence from work) the other day. He's been having a lot of trouble with it. When I told him it wasn't any problem in power plants, he lifted his eyebrows and gave me a look that entitled him to a clip on the jaw.

After he apologized, I tried to explain—and didn't know how. At first, I supposed it's something 'way down deep that makes a man work honestly, or not, and that power engineering happens to appeal to honest men. Yet I've known some engineers that were *not* honest, or willing, or fair, or loyal. But I haven't ever known one who wasn't conscientious about taking his regular shift, or his share of the responsibility.

It may be because power-plant staffs are small, and each man knows what his exact job is. Any shirking by one man in a gang means extra work for the others. A skipped shift for one means a double shift for someone else, and a power failure means extra shifts for everybody until the plant is on the line again.

More likely, it's because every man learns at the very beginning just how important his job is to continued operation of the plant, and that his loafing may cause the shutdown that everybody fears—and constantly guards against.

It's hard for any man, particularly the haphazard, off-and-on worker, to see why it is that his one machine must keep working every shift. There are so many machines like it. The picture is clouded further by bigger wages and longer hours than he is accustomed to, by unexplained stoppages because of design changes or material shortages or inequality of part stocks, by the continual flood of rumors that picture his company's product piled to rust in remote fields or wasted behind the battle lines—even by the traditional American cockiness which assumes we can't possibly lose even if the individual shirks a little.

None of these factors enters the power man's picture. His products are used as fast as produced, usually his plant is the sole source for the factory, building or area he serves, and he knows that if his wheels don't turn, neither do any on the production equipment. He's in the very desirable position of feeling necessary all the time.

Perhaps that's the answer to my friend's absenteeism problem—to find some way to build in each employee's heart the feeling that he is an essential part of the whole—that his job, no matter how remote it may seem, must be done if our kind of living is to keep on. There's need for building the gang spirit—a 130,000,000-person gang working as a unit to beat the Axis. That's a real job for management, one that stuffed shirts can't measure up to.

George Edwards

Engineer

MORE EFFECTIVE SEALS FOR PISTONS AND RAMS...

J-M Moulded Packing Cups are made to take the toughest kind of service on all types of slow-moving pistons and rams operating against air, water, steam, oil, etc. Even against extremely high pressures and temperatures they stand up in service and assure a positive seal with minimum friction.

J-M Moulded Cups are "custom-made" . . . moulded to the exact shape and size required. Their composition can be varied to meet specific service conditions. For details on Moulded Packing Cups and on the complete line of J-M Packings, ask for the J-M Packing Catalog. Johns-Manville, 22 East 40th Street, New York, N. Y.

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POWER LINES

Personal notes, items of general interest, the latest from Washington:—all the news that is news in the power field

New Fuel-Oil Conservation Order Affects Utilities and Industrial Power Plants

OPA has amended the oil-rationing regulations in the 17-state Eastern coastal area to cut off fuel-oil supplies for generation of electric power either by utilities or industrial plants wherever coal or hydro energy can be obtained. Administration of the order is vested in WPB's Office of War Utilities.

The order requires all users of oil for energy generation to hook up with coal or hydro power stations for all their requirements or for as much of them as they can obtain. There are four exceptions:

(1) Where interconnection would require an unreasonable use of critical materials;

(2) Where the interconnection is not feasible because of technical operating conditions, such as different frequencies, etc;

(3) Where power generation is a by-product of plant operations;

(4) Where the shift would cause "an unreasonable interference" with plant operations.

Users of oil for electric generation are required by the order to report to their local ration boards to surrender coupons. Applications for authority to continue use of oil under one of the four exceptions are to be filed with local boards, which are directed to forward them to OWU for a decision.

Continued use of oil is authorized pending decision on the application and until conversion to other power source is made. In addition, the order authorizes all operators of oil-fueled plants to carry a 10-day emergency supply in case of outage or other interruption of service. Oil-fired generating plants of less than 100-kw rated capacity also are exempt from the order.

The order results from a series of conferences participated in by OPA, OWU and PAW. It is intended as a further step in the program of forcing industrial conversion in the Eastern seaboard region wherever possible. PAW's oil allocation order, which cuts all but vital industrial oil use to about 40% of pre-war consumption, has been changed to eliminate power generation from the list of exempted uses.

Obituaries

A stationary engineer for the Pullman Co in Buffalo more than 25 years, **Wallace S McPherson,** 77, died suddenly Feb 14 in Onancock, Va.

James G Blunt, 74, assistant to James E Davenport, vice-president in charge of engineering of the **American Locomotive Co,** died Feb 15. In 1897 Mr Blunt accepted a position as draftsman with the Brooks Locomotive Works at Dunkirk, N. Y. From 1899 to 1906 he was chief draftsman there. When the Brooks Locomotive Works was merged with other companies into the American Locomotive Co, Mr Blunt became engineer for the drafting department of the American Locomotive Co, holding this position until 1916 when he became mechanical engineer. In 1936 he was appointed chief mechanical engineer, and in 1941 was named assistant to the vice-president in charge of engineering.

Benjamin A Keiley, chairman of the board of directors of the **Power Transmission Council, Inc,** New York, passed away Feb 17. Mr Keiley was president of the R & J Dick Co, Inc, of Passaic, N. J., and the Barry Pulley Co, Muscatine, Iowa. At the time of his death, in addition to his business

(*Continued on page* 176)

Changing your address soon?

You will help us give you the good service that is your due by notifying us at once of your change of address. Often the monthly issues of POWER go out of print almost immediately after publication, preventing us from supplying issues that may have been misdirected. Prompt notification of address changes that have been made or will be made prevent your missing a single one of the big valuable monthly issues of POWER.

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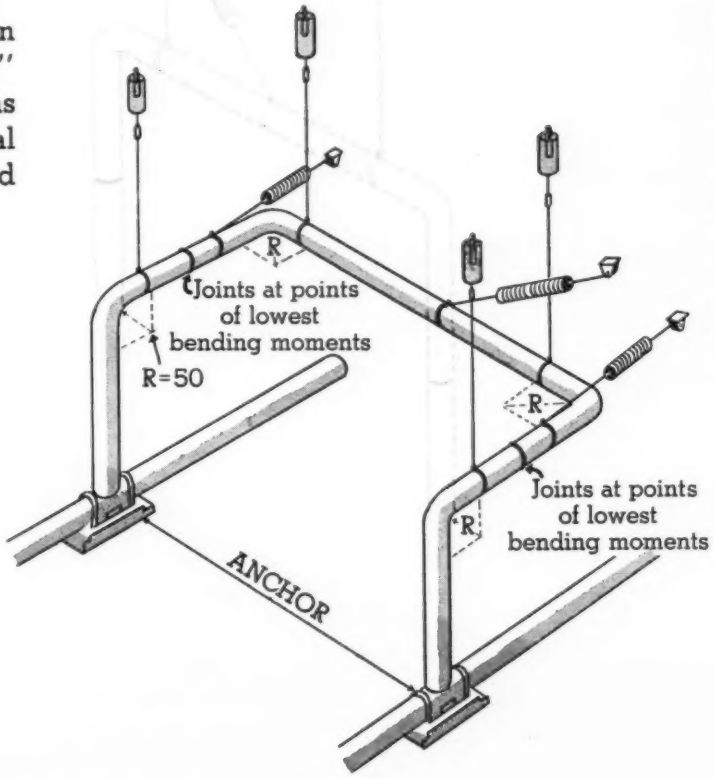
THE SCIENTIFIC APPROACH TO YOUR PIPING PROBLEMS

One example of "Scientific Approach to Piping Problems," illustrates a suggestion for a two plane "U" bend as a simplified as well as an economical design for low head room conditions.



Spring assemblies are all of the same length at the same elevation away from interconnecting piping, valves, covering, etc., presenting a remarkably neat appearance.

Functional Hangers and Vibration Eliminators permit unrestricted line movement. Exclusive features allow swivel action in all directions and eliminate metal fatigue.

POWER PIPING DIVISION presents the ultimate in ENGINEERING • PREFABRICATION • ERECTION

- **Engineering**
- **Prefabrication**
- **Erection**

The employment of FLEX-ANAL CHARTS* enabling engineers to simplify and quickly arrive at an economical design.

All sub-assemblies are completed under rigid engineering control. This results in a negligible amount of field welding and simplifies erection.

Highly developed procedures employed provide the last word in economical erection. The use of Functional Hangers and Vibration Eliminators adequately control the behavior of your piping system.

* The correlated use of FLEX-ANAL CHARTS and HANGER BULLETIN 1863 saves time in engineering man power which can be devoted to other useful purposes. Copies of these books can be obtained through a request on your business letterhead.

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

Prevent Valve Failure

This illustration shows the too common result of using a renewable composition disc valve for continuous throttling service. The bronze valve body was ruined by the effects of "wire drawing". The seat (1) was cut away; the outlet side of the diaphragm was penetrated (2).

Many of your renewable disc seat valves in throttling service may meet the same fate unless immediate action is taken to save them. Ordinarily, it might be possible to replace them with plug-type seat valves, which are designed to stand severe throttling service. But, today, plug seat valves are hard to get because of the special alloy used for the seat ring and plug, and it may often be necessary to get along with the renewable disc valves now in service . . . to make the simple change that will convert them to withstand throttling.

This change can be quickly and easily made in a Jenkins Standard Bronze Globe or Angle Disc Valve by adding a Jenkins Throttling Nut (Fig. 344). This provides an effective substitute for plug type valves. It reduces to a minimum the damaging effects of wire drawing, and greatly increases the life of a valve.

It is important for every plant to take full advantage of this application as a means of conserving valves. Since valve failure today can stall production of material vitally needed by our armed forces, and since preventable wear is a needless waste of scarce valve metals, it is the patriotic duty of every plant management to insist on effective conservation.

Most valve trouble can be prevented before it starts . . . by frequent, thorough inspection . . . by repair or replacement of worn parts in time to prevent valves from destroying themselves. New maintenance workers should be taught to detect the first signs of trouble . . . to correct it without delay. Valves for approved new construction should be carefully selected, and properly installed by experienced workmen.

Consult Jenkins Engineers for assistance in improving your system of valve conservation.

Jenkins Bros., 80 White Street, New York, N. Y.; Bridgeport; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.

JENKINS VALVES

before it starts!

Add This Unique Throttling Nut to Your Jenkins Renewable Disc Valves in Throttling Service . . . Increase Valve Life 5 to 10 Times

Any Jenkins Renewable Disc Valve can be converted for throttling service by removing the standard disc nut (A) from the standard disc holder, and replacing it with a Jenkins Throttling Nut (Fig. 344) (B) to obtain the unit (C).

With this change, Jenkins Standard Bronze Globe or Angle Disc Valves can be used for a wide variety of industrial services where throttling is a factor . . . for the control of small reciprocating pumps and auxiliary equipment . . . for boiling and cooking kettle services . . . for regulating the flow of steam, air, gas, oil, hot and cold water and various other fluids.

The lugs on the Throttling Nut provide orifices which restrict the flow of liquids. Before any appreciable volume of fluid can pass through the throttling nut orifices, the seats are separated to such an extent that the destruction from wire drawing on both seat and disc is reduced to a minimum. With this protection, the seat and disc last much longer when the valve is installed in the customary position – with the inlet pressure beneath the seat, as shown in the diagram (C).

Where conditions make it necessary, or where the service permits it, still greater efficiency can be obtained if the valve is reversed in the line, so that the inlet pressure is applied on top of the disc, as in diagram (D). This permits the expansion or discharge of the fluid through the ports into the central chamber of the throttling nut, eliminating the danger of impingement effects, the most common cause of seat and disc destruction.

In many instances, the service life of these parts has been extended 5 to 10 times and more. The scarcity of valve parts and rubber composition discs makes it imperative that such an easily-effected saving as this be immediately adopted.

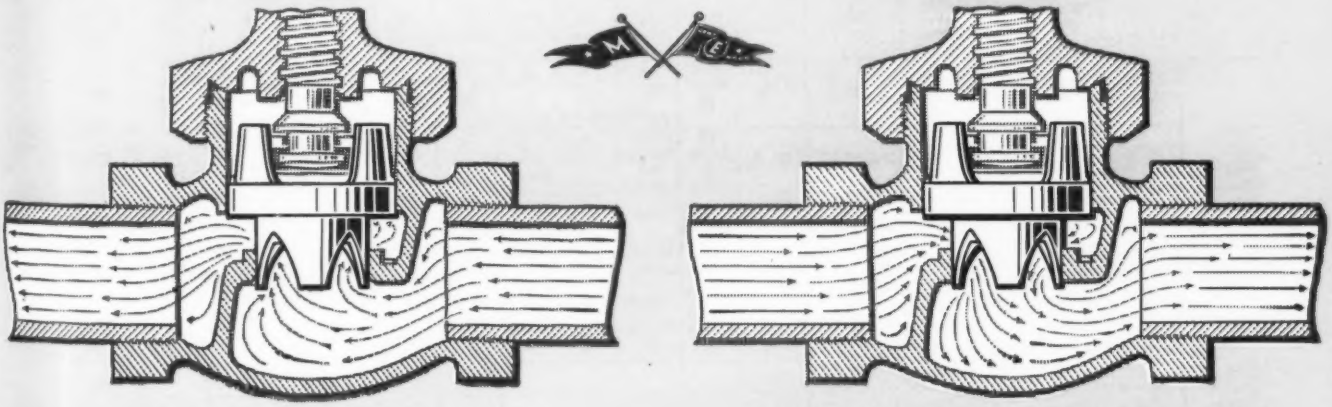
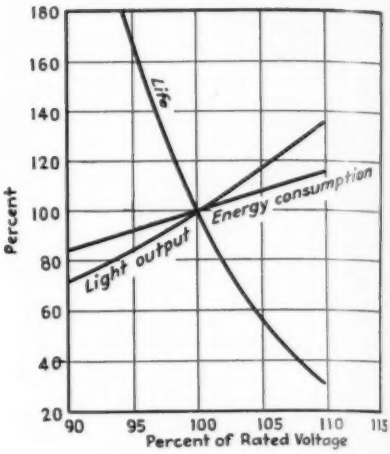


DIAGRAM-C DIAGRAM-D

For every industrial, engineering, marine and power plant service

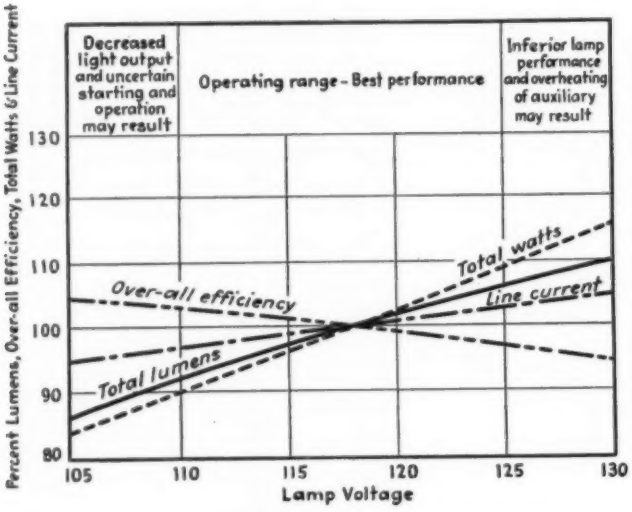
BRONZE ★ IRON ★ STEEL

Effect of Voltage Variation



Characteristic curves for incandescent lamps show rapid decrease of life at overvoltage, loss of light output at undervoltage

Characteristic curves of fluorescent lamps (with ballasts) indicate that varying voltage has little effect on lamp life but high voltage may overheat ballast



► MOTORS, INCANDESCENT LAMPS and fluorescent tubes react differently to voltages above and below their normal range of best performance. These curves and table from a recent utilization-voltage standardization report of the Edison Electric Institute offer a quickly-grasped understanding of what happens.

Overvoltage cuts life of incandescent lamps drastically; undervoltage reduces light output somewhat but reduces wattage input. Fluorescent units suffer little from small variations either way but excessively low voltages cause lamp flicker and high ones overheat the ballast.

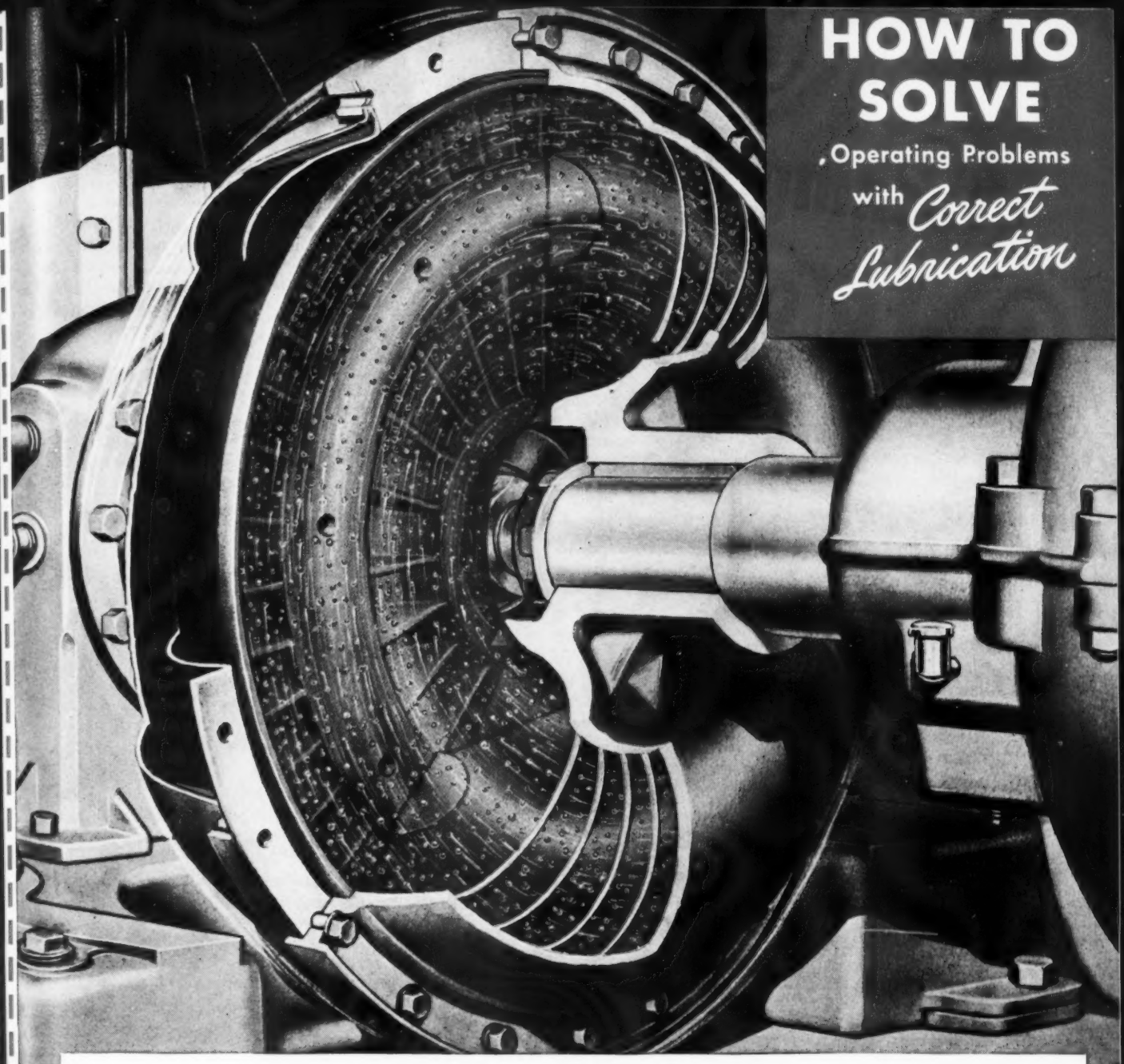
Effect of varying frequency as well as voltage is indicated in the table for general-purpose motors. Quantities are suggestive of degree of variation and will vary somewhat for specific ratings.

General Effect of Voltage and Frequency Variation on Induction-motor Characteristics

■ – Increase ▲ – Decrease

		Starting and Maximum Running Torque	Synchronous Speed	% Slip	Full-load Speed	EFFICIENCY			POWER-FACTOR			Full-load Current	Starting Current	Temperature Rise, Full Load	Maximum Overload Capacity	Magnetic Noise, No Load in Particular
						Full Load	¾ Load	½ Load	Full Load	¾ Load	½ Load					
Voltage Variation	120% Voltage	■44%	No change	▲30%	■ 1.5%	Small ■	▲ ½ to 2 points	▲ 7 to 20 points	▲ 5 to 15 points	▲ 10 to 30 points	▲ 15 to 40 points	▲11%	■25%	▲ 5 to 6 C	■44%	Noticeable ■
	110% Voltage	■21%	No change	▲17%	■1%	■ ½ to 1 point	Practically no change	▲ 1 to 2 points	▲ 3 points	▲ 4 points	▲ 5 to 6 points	▲7%	■10 to 12%	▲ 3 to 4 C	■21%	Slight ■
	Function of Voltage	(Voltage)²	Constant	1 / (Voltage)²	(Syn speed slip)	—	—	—	—	—	—	—	Voltage	—	(Voltage)²	—
	90% Voltage	▲19%	No change	■23%	▲1½%	▲ 2 points	Practically no change	■ 1 to 2 points	■ 1 point	■ 2 to 3 points	■ 4 to 5 points	■11%	▲ 10 to 12%	■ 6 to 7 C	▲19%	Slight ▲
Frequency Variation	105% Frequency	▲10%	■5%	Practically no change	■ 5%	Slight ■	Slight ■	Slight ■	Slight ■	Slight ■	Slight ■	Slight ▲	▲ 5 to 6%	Slight ▲	Slight ▲	Slight ▲
	Function of Frequency	1 / (Frequency)²	Frequency		(Syn speed slip)	—	—	—	—	—	—	—	1 / Frequency	—	—	—
	95% Frequency	■11%	▲5%	Practically no change	▲ 5%	Slight ▲	Slight ▲	Slight ▲	Slight ▲	Slight ▲	Slight ▲	Slight ■	■ 5 to 6%	Slight ■	Slight ■	Slight ■

© POWER



HOW TO SOLVE

Operating Problems with *Correct Lubrication*

Beware of Oxidation Here

PROBLEM: In this hydraulic coupling the power is transmitted by the oil in the shell. *What happens to the oil?* It is whipped and churned into a violent whirlpool. It gets hot. It mixes intimately with air. Unless the oil is specially made to resist oxidation under these conditions, it will form deposits which will interfere with the correct operation of the coupling.

ANSWER: You'll find Gargoyle Vacuoline Oils ideal for hydraulic systems. They've been designed to stand up under tough oxidizing conditions and give freedom from trouble-causing deposits. And they do it! Our man can give you plenty of proof of that. And, of course, the Gargoyle trade mark stamps it as an oil on which no corners have been cut. It's the finest oil our 77 years of experience can produce for this purpose!

GARGOYLE Lubricants

SOCONY-VACUUM OIL COMPANY, INC. — Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California

CALL IN SOCONY-VACUUM

Working Side by Side FOR VICTORY

Old and New DART UNIONS

There is no "retiring age" for a Dart Union. If there is important work to be done, even though a Dart has seen *plenty* of service already, it can still see plenty more. And give tight-joint performance, too.

In a nutshell, here is the explanation of how Dart Unions can pay extra dividends in trouble-free performance and long life. Matched bronze seats, precision machined and ground to accurate "true-ball" surfaces make it possible for Darts to be used many times. Nuts and bodies made of heavy air refined malleable iron give Darts their ability to resist rough handling and pipe strains.

It is common sense and good patriotism to search out your plant for your old Darts and put them back to work. It is sound and far-sighted judgment to see your distributor now for new Darts, if you need them.

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

Waste Fuel Burning

(*Continued from page* 75)

a greater amount of fuel undergoes progressive drying, distillation and combustion than would be the case were the edges open to gas travel. This condition permits higher undergrate pressures and, in consequence, more even distribution of primary air up through the mass. There is less tendency for blow-holes to form, as they tend to form along the path of least resistance. Such a path being on an angle, offers the greatest chance for self-plugging because of the mass of fuel above.

The amount of primary air required in this case is a minimum. Kreisinger's data indicate that only 10% of the total air is required as primary air. His analysis assumes that no excess air enters through the grates. It applies here because the average fuel depth is such as to discourage formation of blow-holes, which are a source of excess air. With an ordinary full grate, or one with its center blanked off, blow-holes form easily around the edges and thus excess air enters through the grates. This fact reconciles Kreisinger's data with observations made on installations throughout the Northwest that from 50% to 70% is required as undergrate air. In this case the term primary air is wrong; it is really secondary air passing through the blow-holes.

Two Trial Runs

To test the validity of the preliminary analysis, our plant made two trial runs about six months apart, each over a 48-hr period on a different boiler. The grate surface of each boiler was blanked off with brick, leaving a 6-ft diameter area open under each of the four feed holes. Integrators had not as yet been installed in the boiler flowmeters, so the total steam generated was not determined. The tests, however, were merely to try out an idea; so comparison was made on the basis of average steaming rate and maximum sustained rate before, during and after runs.

In both tests, average steaming rate had been holding about 65,000 to 70,000 lb per hr. During the first test, neither the firemen nor I could see any appreciable difference. With firing at about the same rate of fuel input and flue-gas temperatures about the same, the only differences we noted were of a minor nature: A higher undergrate pressure was required, the pressure drop

"Too bad for me all right, if they keep giving me the go-by with the oil can. Another day or two and—war or no war—I'm going to quit!"

"Can't really blame Joe for it either. With all the extra work he's been doing over in the annex, he had to cut down somewhere, I suppose."

"Brrrr—here come the 'shakes' again, all on account of that loose bolt in the base plate. If only I could holler 'Uncle,' instead of just sitting here battering my bearings out."

"Funny how people are. After I pass out tomorrow there'll be a regular clinic around here. Once I'm a 'has-been,' I'll be the most important motor in the shop."

Preventive Care of Motors

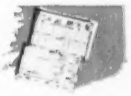
. . . IS A MANAGEMENT PROBLEM

HERE'S HOW G.E. CAN HELP YOU SOLVE IT

A regular schedule for oiling, cleaning, and inspection of every motor is half the battle in keeping motors fit.

The G-E booklet "How to Care for Motors" tells what to do and when to do it. You can use it as a basis for issuing definite instructions, and for analyzing the hours of work involved so that your maintenance crews can be adequately staffed. Ask for GEA-2856A.

To get the most out of motors, and to meet new WPB requirements, the required horsepower for every job must be accurately known. On metal-cutting operations, the new G-E MOTORULE is just what you need to determine your requirements. Simple to use, it saves time and saves motor horsepower. Ask for GEL-763.



Free G-E Motor Record Cards (GES-1526A) make it easy to keep a convenient record of the specifications and service history of every motor in your plant.

BUILDER OF TRI-CLAD MOTORS

GENERAL ELECTRIC

General Electric, Sec. F 750-208, Schenectady, N. Y.

Yes, please send me:

- ☐ "How to Care for Motors" (GEA-2856A)
- ☐ G-E MOTORULE (GEL-763)
- ☐ A supply of ..... Motor Record Cards (GES-1526A)

Name .....

Company .....

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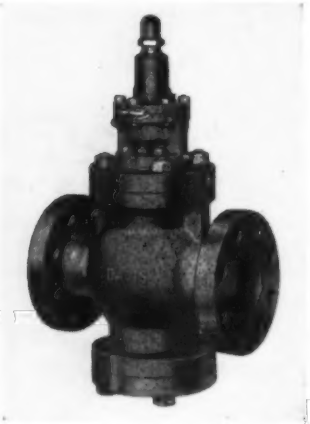
City ..... State .....

THERE IS NO JOB
for
PRESSURE REGULATORS
THAT CAN'T BE HANDLED
by a
DAVIS
PRODUCT

Above—No. 401—a compact, instrument type regulator for accurate, sensitive pressure control. Sizes ½ to 10".



Above—No. 40—for heavy duty, variable load conditions. Sizes ½ to 10".

STANDARD Davis Pressure Regulators are available to meet virtually any requirements. Some models are spring-loaded, others weight-loaded, depending upon which best serves the valve design and application. Because operating conditions vary so greatly, careful selection of the right regulator for the job is of extreme importance. This job, however, is greatly simplified when you specify Davis, for there are eighteen different types to choose from—sizes up to 24" . . . for pressures up to 1500 lbs. And—Davis provides experienced engineering cooperation, informative literature and a handy "Service Selector Chart" to aid you. Write today.

DAVIS REGULATOR COMPANY
2540 S. Washtenaw Ave.
Chicago, Ill.

DAVIS VALVES **DAVIS REGULATOR COMPANY**

through the fuel bed being about 1 in. H_2O as against a normal half-inch drop. Carryover of fines was considerably less; sensitivity to fuel-bed depth was decreased; and sensitivity to draft control was increased. Forced draft was applied to the ashpit only, with overfire air admitted through an opening on top of the front wall. This source of overfire air was found to be inadequate so feed-hole covers were left open.

For the first test, the boiler was equipped with a flowmeter having a capacity of 75,000 lb per hr. When forced before and after the run, the steaming rate exceeded this value, the pointer being against the pin. The same thing occurred during the run, with possibly a little more trouble to hold at that rate. For average firing, however, the boiler generated as much with little, if any, special attention.

Overfire Air

For the second test, the boiler was equipped with 50% greater forced-draft capacity than the first boiler. Overfire air was supplied by forced-draft fans. An 85,000 lb-per-hr meter was installed. When the boiler was forced during normal operation, we learned that this meter also had insufficient capacity. With good fuel, we put the meter up to the pin. When run with the reduced grate area, the boiler responded about the same as the one previously tested.

This time the effect of fuel composition was particularly noticeable. The optimum ratio of overfire to undergrate air was found to vary with the percentage of sawdust. High percentages required from 70 to 80% overfire air; low percentages from 50 to 70%. Probably the reason lies in the fact that interstices between the hogwood particles provide a path for secondary air to enter through the grates.

From the two trial runs we concluded that since virtually the same output was attainable with only 39% of the original grate area, the next step was to design a grate of larger area but of effectiveness at least equal to that obtained during the trials. We considered several ideas, varying from completely redesigning the Dutch oven, making a regular gas producer out of it, to installing a conical grate in existing settings. The former would probably be in order for new installations whereas a modification of the latter would be economically favorable for existing plants.

Another approach to the problem lies in increasing the effectiveness of the flat grate. Theoretically, a level fuel bed is the answer. But this is not

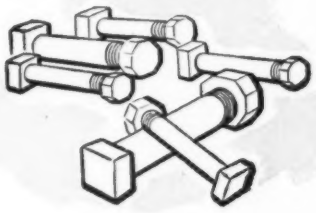
Welding piping with Tube-Turn fittings conserves 4 vital materials . . . checks war-time pipe failures, stops leaks!

NO. 4 OF A SERIES

HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

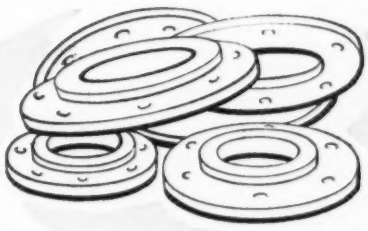
The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

1. NUTS AND BOLTS



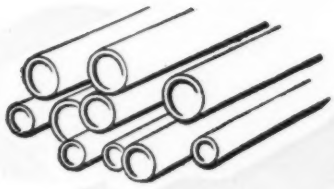
Joints welded with Tube-Turn fittings require no nuts or bolts. Maintenance time and trouble spent in tightening bolts is eliminated.

2. FLANGES



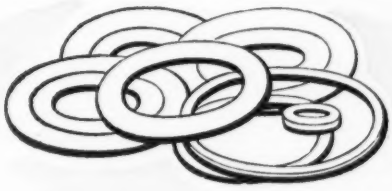
Welding fittings supplant the need for many of the flanged joints necessary in screwed piping—save both weight and critical metal.

3. PIPE REPLACEMENT



When welding fittings are used, you never have to replace any pipe because of worn threads or damage due to replacing flanged fittings.

4. GASKET MATERIAL



Fewer flanged joints mean fewer gaskets to replace. No materials or time wasted when connections are welded with Tube-Turn fittings.

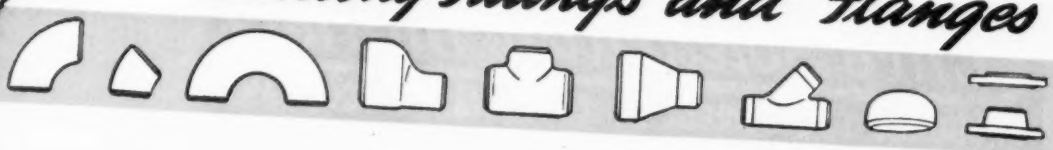
When you multiply these savings over an entire piping system, the amount of critical materials conserved is tremendous. Tube-Turn welding fittings aid the war effort in *other* ways, too—less danger of plant shut-downs due to piping failures; maintenance is virtually eliminated; less installation time is needed because alignment is easier, only simple butt welds are required, and complete sections may be pre-assembled then welded into position. For *stronger, lighter, permanently leakproof* piping systems—weld with Tube-Turn fittings!

TUBE-TURNS (INC.) LOUISVILLE, KY. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Tulsa, Houston, Los Angeles. *Distributors in principal cities.*

TUBE-TURN

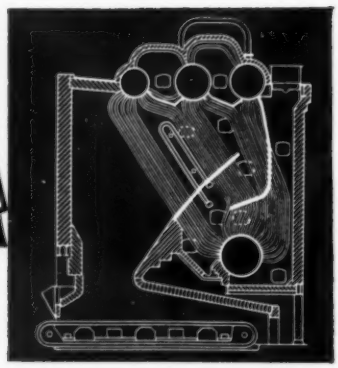
TRADE MARK

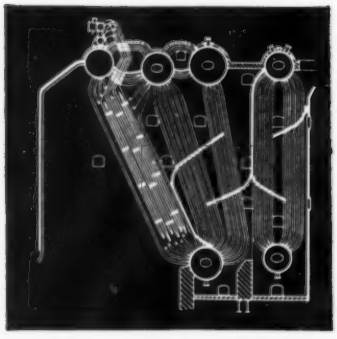
Welding Fittings and Flanges

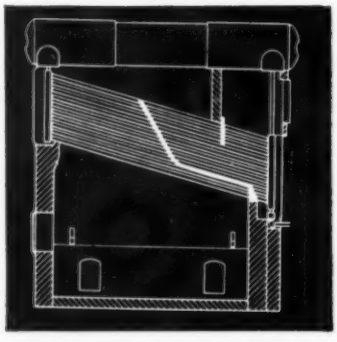


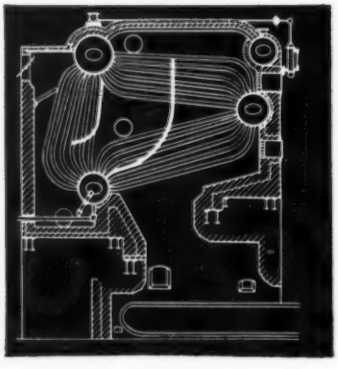
MORE STEAM

Procurable with Improved Baffles









Demands for greater boiler output are often met by installing more efficient baffles.

Overload operation need not be destructive nor cause serious outages due to furnace failures when the heat path through the boiler is well designed.

Enco baffling boosts steam output safely. The cross flow puts every foot of heating surface to work. The streamlining prevents eddy currents and dead gas pockets.

Enco baffles also cut down draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are used more effectively and less often. They can be applied to any water-tube boiler.

Each application is individually designed by men with 25 years experience in this highly specialized branch of engineering. Installations are made by skilled mechanics.

● ***A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.***

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

so good from a practical standpoint because blow-holes have a tendency to form and are hard to plug, particularly with a light fuel such as wood. With a conical grate, blow-holes tend to form on an angle; pressure of the fuel above is exerted downward, tending to throttle the blow-hole rather than plug it from the end as in the case of a flat fuel bed. A spreader stoker has been considered as a means of providing a level bed of uniform depth. If the quality of the fuel could be controlled to the extent of providing a relatively uniform range of particle size, trouble caused by blow-holes could be greatly minimized. This, however, does not appear feasible because economic value of the fuel is low and provisions must be made for burning the sawdust.

My reaction is, in general, favorable to a conical grate, preferably water cooled. The sketch on page 72 illustrates the general idea of the type of grate in mind. Being water cooled, it can be used with preheated air, and clinkers will not form and cause trouble. If installed in a well setting, it becomes essentially a gas producer. In fact, all Dutch ovens are nothing more or less than gas producers directly connected to a combustion chamber.

Packing Problems

(*Continued from page 72*)

Then additional rings are installed and each ring is pressed tightly against the preceding one. Finally, when the entire set of packing is properly installed, a small amount of leakage should be noticed after suction pressure has been applied. The pump is now started and brought up to operating speed for a few seconds and then shut down again. This is repeated many times to burnish the packing and to rub off some of the covering or binder used in the material. The pump is then put on the line, ready for use, provided local overheating during the breaking-in process did not damage the shaft sleeves by producing heat cracks on their surface.

Motor Failure

On smaller pumps having severe suction conditions, motor failure caused by overload may occur when the stuffing-box packing has been pulled too tight.

Pumps are usually supplied to the customer without packing in place because it has a corrosive action on the shaft-sleeve surface when the pump shaft is at rest. If the customer does not make the initial packing installa-

Establishing Durability Records on the Production Line

Many a far-sighted plant manager who authorized copper tube installations before the war, is cashing in today on increased production and low-cost maintenance—with no costly shutdowns due to rust-caused repairs.

Anaconda Copper Tubes, with solder-type fittings, not only provide economical first cost, but many other advantages of particular value at this time. They stubbornly resist corrosion. They reduce pumping costs, thanks to smooth interiors that offer least resistance to flow. They save space . . . are easy to bend . . . easy to adapt to changed plant layouts.

Today, of course, except where no other material will serve, Copper Tubes cannot be supplied for pipe lines or other industrial uses. Copper is too essential for countless war applications. But it will be worth your while to obtain for future reference, if not for present use, a copy of our Publication C-24. Write us for "Anaconda Copper Tubes for Industrial Applications."

4349

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn.
Subsidiary of Anaconda Copper Mining Co.
In Canada
Anaconda American Brass Ltd., *New Toronto, Ont.*

ANACONDA

Anaconda Copper Tubes

No Mumbo Jumbo about High Pressure, High Temperature Piping

All the ju-ju in darkest Africa cannot influence power piping fabrication. But possibly there have been times when, in desperation, one has wondered if a bit of authentic mumbo jumbo wouldn't help.

However, why anticipate or even tolerate high pressure, high temperature piping problems? Permit Associated to assume these responsibilities. Here is organization, experience, skill and most modern equipment for pre-heating, stress-relieving operations, ready for high gear action—now!

Photograph above shows prefabricating on a carbon moly high pressure, high temperature power piping job.

WAR PRODUCTION . . . This company is engaged in high priority war production, proud of its responsibilities and fulfilling them to the letter.

ASSOCIATED PIPING & ENGINEERING COMPANY
2332 EAST 38TH STREET
LOS ANGELES, CALIFORNIA

tion correctly, he may damage the stuffing-box parts.

If the packing proper is augmented with auxiliary equipment, such as a high-pressure breakdown or cold-liquid injections, Fig. 1 and 2, operation of the entire stuffing box and its piping, gages, valves, etc, may become quite complex. Starting procedure may become rather involved and special, lengthy instructions may be required for operation. Furthermore, the power lost by either bleeding or injecting is considerable, the heat balance of the whole installation may be affected, and certainly the over-all efficiency of the unit is decreased. These difficulties have led to giving considerable attention to mechanical sealing devices, which will be considered in the next article.

First part of prize paper submitted in contest sponsored by the Hydraulic Institute.

Capacitors

(*Continued from page* 78)

for the motor insulation and a check should be made with the motor manufacturer.

When in doubt a test can be easily made. With the capacitor connected to the motor, connect a voltmeter across the motor terminals. Bring the motor and its load to rated speed, then disconnect the motor from the line, and read the voltage indicated by the voltmeter, which is that caused by self-excitation. If the reading does not exceed 150% of motor-rated voltage, the capacitor kva is within safe limits.

Figuring Capacitor Kva

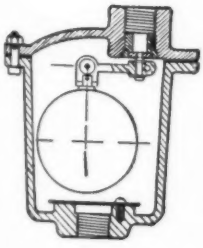
To determine the value of capacitor kva necessary to improve the power factor of an induction motor to a given value, it is necessary to know only the load on the motor and its power factor. The load on the motor can be measured with a wattmeter and its power factor determined with a power-factor meter. Full-load rated values can be read from or calculated from the motor nameplate data. Assume a 50-hp 440-v 575-rpm 60-cycle squirrel-cage induction motor which has a full-load input of 43.5 kw, and an 82% power factor that is to be improved to 95%.

The kilovolt-ampere load, KVA, on the motor equals kilowatt load, KW, divided by the power factor, PF; that is, $KVA = KW \div PF = 43.5 \div 0.82 = 53.0$. Reactive kilovolt-ampere load, $RKVA = \sqrt{KVA^2 - KW^2} = \sqrt{53.0^2 \div 43.5^2} = 30.4$. Kilovolt-ampere load

HOW TO CHOOSE A STEAM TRAP

this Book tells

and how to remove air and gas from liquids under pressure



The book "How To Choose A Steam Trap" not only gives complete information on steam traps, but also contains complete data on Air Release Valves, also called air traps. These valves are used solely for venting air from water or gas from liquids in a pipeline or closed vessel. Installed at high points, the air is vented automatically and with certainty.

Anderson Air Release Valves are widely used for venting air from hot water service lines (particularly in tall buildings), from hot water heating systems, water mains, oil lines, brine lines, and for venting air or gas from other liquid lines and tanks under pressure.

Write for your copy of "How To Choose A Steam Trap," giving complete information on these Anderson Air Release Valves.

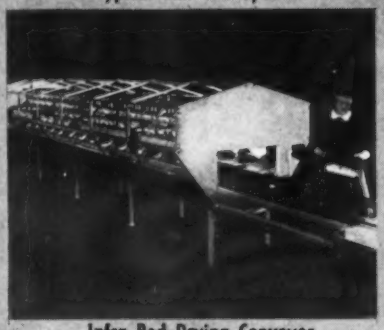
THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland, Ohio

AIR RELEASE VALVES

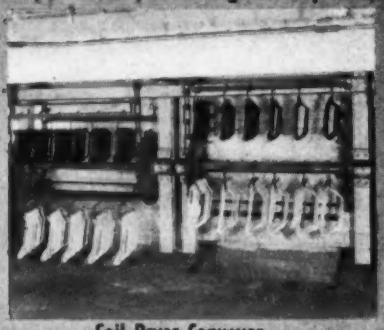
In time of ~~Peace~~ WAR prepare for ~~War~~ PEACE

Typical Slat Conveyor

Special Conveyor handling machine parts



Infra-Red Drying Conveyor



Coil Dryer Conveyor

• George Washington's advice is good even in reverse. It's none too soon to think of preparing to help meet the huge coming demand for peace-time goods. Why not now, while time permits, let Gifford-Wood plan with you to develop a material handling system that will enable you to compete successfully with others seeking the same business you will want?

There's real help along these lines available in the G-W organization. With unmatched experience in planning equipment and layouts, with many standard designs that are readily adaptable to special conditions, with an engineering development staff organized to tackle tomorrow's jobs as well as today's, G-W can relieve your busy engineers by working with them so you'll not lose months waiting for reconversion when that happy need arises.

While G-W shops are busy turning out war-time equipment, the engineering staff is adequate to give thought to the tomorrows. As a first step, you might look through G-W Catalog No. 200-P a 125-page idea book on elevating and conveying equipment for handling bulk and packaged materials as well as parts in process of manufacture. A request on your business letterhead will speed a copy to you.

CONVERTED TO COAL? If not, let G-W engineers show you how to convert quickly for little money.

DRYING AND BAKING METAL FINISHES? If you still use ovens, let G-W show you how to cut production time 75% and space 50% with an Infra-Red system.

GIFFORD-WOOD CO.

FOUNDED 1814

420 Lexington Avenue
New York

HUDSON, N. Y.

565 W. Washington Street
Chicago

Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes
Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers
Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries

3665

at 95% power factor is $KVA = 43.3 \div 0.95 = 45.8$ and the reactive kilovolt-ampere load, $RKVA = \sqrt{45.8^2 - 43.3^2} = 14.2$. Kilovolt-ampere rating of a capacitor to improve the power factor to 95% equals the reactive kva of the original conditions minus the reactive kva of the load when the power factor is improved. In this case, capacitor kva = 30.4 — 14.2 = 16.2. The correct capacitor would be a standard 460-v 15-kva unit. This capacitor will operate on 440 v. Kva rating of a capacitor varies as the voltage at its terminals squared. Then on 440 v, the 460-v capacitor will have a rating of $15 \times 440^2 \div 460^2 = 13.7$ kva and will improve the power factor to 93.4%.

A capacitor selected on the basis of improving the power factor of an induction motor to 95% at full load also gives reasonable improvement at reduced loads. For example, at one-half load the 50-hp motor has a 65% power factor and the 15-kva capacitor improves it to 88%.

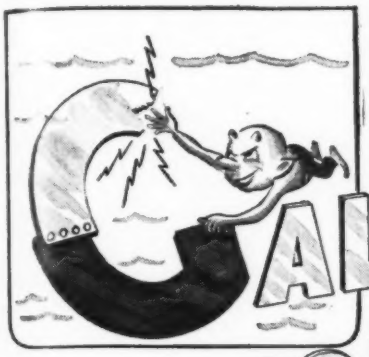
Transformers

(*Continued from page* 81)

the total required substation kva rating and would be connected to the low-voltage substation through a breaker. This type of substation gives the needed reliability. If trouble develops in one 3-phase transformer, which is very remote, it can be switched out and service restored immediately to at least the essential plant load. With three single-phase transformers, the damaged transformer would have to be located and disconnected before service could be restored. To disconnect a damaged single-phase transformer, and operate the remaining two sound transformers in open-delta usually takes several hours. A considerable part of this time usually is spent in hunting to determine which of the three transformers is in trouble.

If additional reserve capacity is required in the unit substation, each 3-phase transformer can be equipped with fans to increase its overload rating 25 to 33% of the self-cooled rating. In the usual kva-transformer sizes, additional load obtained from forced-air cooling is appreciably greater on a 3-phase transformer than on an equivalent kva bank of three single-phase transformers. Also, if the plant load drops to less than half of full substation capacity, one 3-phase transformer can be removed from service to save its losses.

A transmission line with unregulated voltage supplies many load-center sys-



GALVANIC CORROSION

OF DISSIMILAR METALS

And how milliampere Gremlins may be foiled at their own game

Today, dissimilar metals must frequently be used in more or less untried combinations. This is made necessary by metal shortages and urgent production needs.

Such combinations when exposed to liquids or moisture can result in serious galvanic corrosion. Therefore galvanic couples now merit much closer attention by plant and design engineers than was previously necessary.

Also, since its effects are not readily distinguished from those of the ordinary types of corrosion, it frequently is blamed for troubles it could never cause. Yet when really present, galvanic corrosion may be very serious.

Practices for controlling Galvanic Corrosion

1 Select combinations of metals as close together as possible in the Galvanic Series.

2 Avoid combinations where the area of the less noble material is relatively small. It is good practice to use the more noble metals for fastenings or other parts in equipment built largely of less corrosion resistant material.

3 Insulate dissimilar metals wherever practical. If complete insulation cannot be achieved, anything such as paint or plastic coatings at joints to increase the resistances of the circuit will help.

4 Keep dissimilar metals as far apart as possible. This rule applies even when the actual connection between the metals is made external to the corrosive liquid.

5 Apply coatings with caution. For example, when painting—do not paint the less noble material without also coating the more noble, otherwise greatly accelerated attack may be concentrated at imperfections in coatings on the less noble metal. *Keep such coatings in good repair.*

6 Prevent or limit aeration of the corrosive liquid as much as possible to sustain the polarizing effect of the hydrogen film which forms on bare cathodic surfaces.

7 If practical, add chemical inhibitors to the corrosion solution according to the nature of the solution to be inhibited.

8 Avoid joining materials well apart in the series by threaded connections, as the threads will probably deteriorate excessively. Brazed joints are preferred when practicable.

9 Whenever possible, install relatively small replaceable sections of the less noble material at joints and increase the thickness of the less noble material in such regions; for example, by using extra heavy wall nipples in piping or by attaching replaceable pads to critical surfaces.

10 Install pieces of bare zinc or steel to provide a counteracting galvanic protection effect to suppress galvanic corrosion.

•

INCO's Technical Service is prepared to assist metal users in solving galvanic corrosion problems. Available data from INCO's Corrosion Files for a particular combination of metals will be furnished wherever possible. Aid can also be extended in applying general principles to specific problems.

As a first step in securing INCO's help on a specific corrosion problem, write for a copy of the Corrosion Data Work Sheet.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York, N. Y.

GALVANIC CORROSION *and* THE GALVANIC SERIES

Galvanic Corrosion is caused by contact or connection of unlike metals in a corrosive liquid. Because generation of electric current is associated with galvanic corrosion, the metals act like a galvanic cell and corrosion action may become more serious and more rapid than that fostered by the corrosive liquid acting on the metals separately. Such action may be prevented or minimized by using the Galvanic Series to guide the selection of metal combinations.

GALVANIC SERIES

Corroded End (anodic, or least noble)

Magnesium
Magnesium alloys

Zinc

Aluminum 2S

Cadmium

Aluminum 17ST

Steel or Iron
Cast Iron

Chromium-iron (active)

Ni-Resist

18-8 Stainless (active)
18-8-3 Stainless (active)

Lead-tin solders
Lead
Tin

Nickel (active)
Inconel (active)

Brasses
Copper
Bronzes
Copper-nickel alloys
Monel

Silver solder

Nickel (passive)
Inconel (passive)

Chromium-iron (passive)
18-8 Stainless (passive)
18-8-3 Stainless (passive)

Silver

Graphite
Gold
Platinum

Protected End (cathodic, or most noble)

According to studies and practical experience from which the Series resulted, metals within a group have no strong tendency to produce galvanic corrosion of each other and therefore make relatively safe combinations unless the area of the less noble is markedly smaller.

The coupling of two metals from different groups and distant from each other in the list can result in galvanic, or accelerated corrosion of the less noble material. The farther apart the metals stand, the greater will be the galvanic tendency.

Although the arrangement of metals in the Series is based on results of experiments and practical experience involving many common corrosives, it cannot replace the need for tests when unusual corrosives are encountered or when other unusual conditions prevail that may cause major shifts of the relative positions of metals in the Series.

MURRAY TYPE "U"
Mechanical Drive Turbines

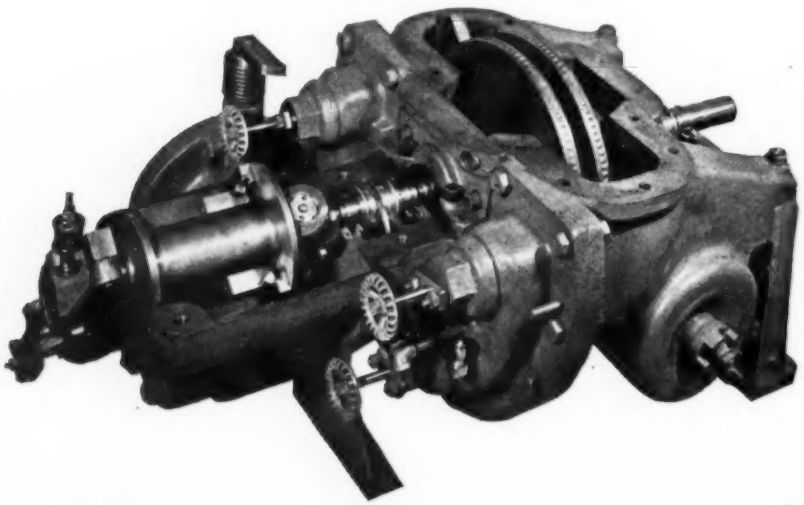
• Many of the advantages of the MURRAY Type "U" Mechanical Drive Turbines are illustrated in the accompanying internal view. The most outstanding feature is the arrangement of the casing, which as shown is split horizontally well above the shaft center line. This unique and patented construction provides the following desirable features:

1 Longer steam ring allowing considerably more nozzle area and larger steam inlet size, thereby increasing the maximum horsepower developed by a particular frame.

2 Larger exhaust opening which permits of greater horsepower and improved efficiency, particularly for condensing operation.

3 Additional hand valves for nozzle control. (Note that view shows three hand valves on our smallest frame, whereas the usual small conventional turbine has room for only one.)

Other desirable features shown are the stainless steel blading and shroud, center line exhaust end support, flexible steam end support, balanced governor assembly, precision bronze backed babbitt lined bearings, effective bronze labyrinth type oil seals which supplant the older felt type and separate removable upper carbon packing gland cases.



BOILERS TURBINES ENGINES

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

tems. Fluorescent lights used extensively in plants and many other loads are affected by voltage variations. Voltage regulation for these plants can be obtained from load-ratio-control, which is much more readily adaptable to 3-phase than single-phase transformers.

Thus, when reserve transformer capacity is required, the double-transformer unit substation with forced-air cooling is one way to meet this requirement. Likewise, 3-phase transformers can be obtained with load-ratio control for bus-voltage regulation if the load requires a regulated voltage.

New Equipment

(*Continued from page* 130)

in weight, it can be rolled or folded up for easy handling and cleaning. Lying flat, it follows the contour of the floor. The matting is said to make for safety under foot, comfort to stand on and afford good drainage. The ends are beveled to reduce danger of tripping. Wood link matting is particularly applicable for use in plants around machinery on oily and greasy floors, etc. *American Mat Corp, Toledo, Ohio.*

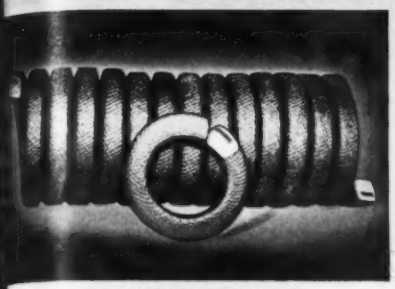
Safety Extension Light

SAFETY EXTENSION LIGHT composed of indestructible materials to eliminate need for repairs and replacements. Entire device is made of non-conductive materials, removing electrical-shock hazard and short-circuit danger. Bulbs can be replaced quickly as guard is removed without using tools. Heavy fiber guard serves as an on-and-off switch; when it is unscrewed, current is cut off automatically. *Davis Emergency Equipment Co, 45 Halleck St, Newark, N. J.*

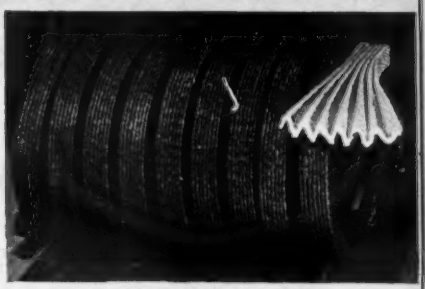
Fluorescent Fixture

"CAPTIVE LATCH," POWERFUL, SPRING-TYPE FASTENER, holds composition reflector securely to top housing of fluorescent fixture. Only a quarter turn required to remove reflector, no tools are needed and latch cannot drop out. Inconspicuous in its position, latch does

BUY U. S. WAR BONDS
AND STAMPS



ANKORITE STYLE 210
A high-pressure packing of best grade asbestos fibre, woven into a tightly meshed cloth, impregnated with a proven heat resisting compound and formed into packing sections with a rubber cushion back.



ANKORITE STYLE 913
High grade woven asbestos of accordion plaited construction which permits wear on the edgewise plies. Binder is a high heat-resisting rubber compound or ANKOPRENE . . . Used extensively for both ball and expansion joints.

THE ANCHOR PACKING CO.

1908 TRADE MARK 1943

Engineers responsible for the production and delivery of power have depended on ANCHOR packings to maintain high efficiencies for the past 35 years . . . And there are three sound reasons for this preference (1) ANCHOR quality is uniformly and dependably high (2) The line of Metallic and Fibrous packings is unusually complete as to type and application (3) ANCHOR Branch Offices in principal cities are adequately stocked for quick service and each is headed by a specialist who knows packing and packing problems . . . Depend on ANCHOR for RESULTS.

THE ANCHOR PACKING COMPANY

MANUFACTURERS—DISTRIBUTORS

METALLIC & FIBROUS PACKINGS FOR EVERY PURPOSE

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FACTORIES: **MANHEIM, PENNSYLVANIA • ELKHART, INDIANA • MONTREAL, CANADA**

BRANCH OFFICES

Baltimore, Maryland	106 Stewart Building Gay and Lombard Streets
Boston, Massachusetts	303-04 North Station Building 150 Causeway Street
Buffalo, New York	Andrews Building
Cleveland, Ohio	523-25-27 Rockefeller Building
Chicago, Illinois	200 East Illinois Street
Cincinnati, Ohio	4 West 7th Street
Detroit, Michigan	169 West Jefferson Avenue
Houston, Texas	509 Washington Avenue
Kansas City, Missouri	1332 Oak Street
Los Angeles, California	720 Mateo Street
Montreal, Canada	5575 Cote Saint Paul Road
Milwaukee, Wisconsin	4417 West North Avenue
New Orleans, Louisiana	418 Common Street
New York, New York	100 Sixth Avenue, near Canal
Philadelphia, Pennsylvania	401 North Broad Street
Pittsburgh, Pennsylvania	405 Penn Avenue
Portland, Oregon	Terminal Sales Building
San Francisco, California	156 South Park
Seattle, Washington	2207 First Avenue, South
St. Louis, Missouri	1407 Pine Street
Tulsa, Oklahoma	823 South Gary Place
Wilmington, California	207 Avalon Boulevard

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and

. . . you'll use it always

THE ALLPAX CO., INC.

Mamaroneck, N. Y.

•

Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

"Never touch metal to a Gauge Glass"

That's a first rule taught every power plant apprentice—a super legend, like strap oil, left-handed monkey wrenches and printers' type lice. To cut glass, you scratch it. Clean the inside of a gauge glass with a swab on the end of a wire and almost surely you'll scratch it. The scratch may be invisible, but reinstall the glass and turn on the pressure—bang!—another gauge glass blown to smithereens!

Any gauge glass is weakened if it's scratched. But, *unscratched*, PYREX Gauge Glasses last longer than other glasses. That's partly because they are made far stronger than necessary to withstand ordinary plant pressures, and partly because the glass from which they are made is highly resistant to corrosion. In fact, it is so inert to all acids except hydrofluoric, that it has been widely adopted for piping by the chemical industry.

And whether dimly or brightly lighted, PYREX Broad Red Line Gauge Glasses have the added advantage of being easier to read, from a distance. That's a safety feature, as you know if you've been near a glass when it blew. It's an efficiency feature, too—a step-saver and a time-saver.

Next time you call your jobber, specify PYREX Broad Red Line Gauge Glasses.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

not affect appearance or efficiency of reflecting surface. *Sylvania Electric Products, Inc, Lighting Div, Salem, Mass.*

Blueprint Machine

SPEE-DEE PRINTER for making blueprints or black-and-white prints takes only half a minute to complete average operation, with exposure time frequently as low as twenty seconds. Printer is portable table model, in two sizes; for prints up to 12x18, and 18x24 in. Actual printing surface is oversize, thus

preventing crowding of prints, overlapping or blurred edges. Printing on curved glass gives contact without inconvenience of wrapping prints around cylinder. Machine may be used for duplicating tracings, drawings, letters, invoices, or any written or printed matter. *Peck & Harvey*, 4325 *Addison St, Chicago, Ill.*

Anti-Rust Agent

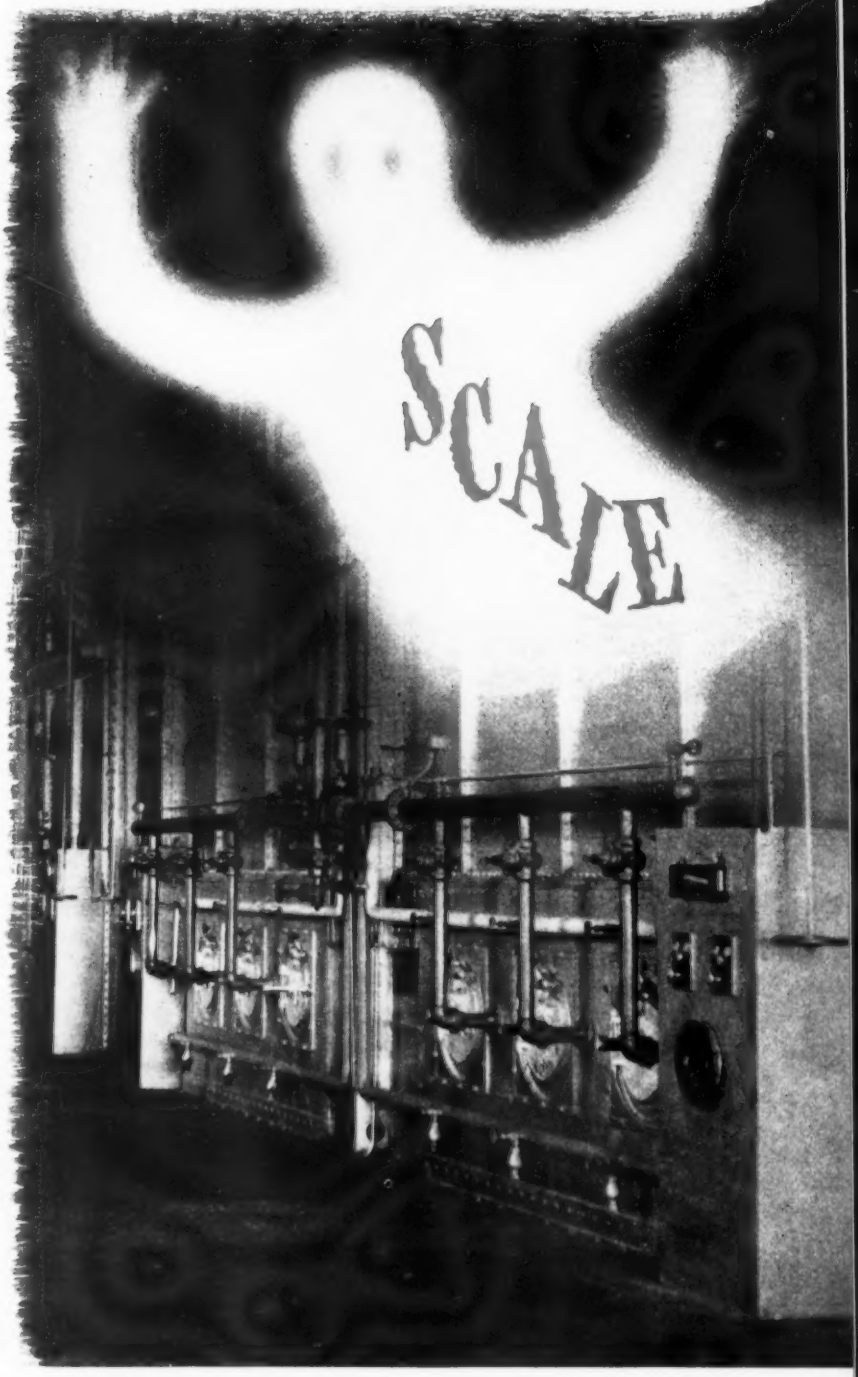
ANTI-RUST, anti-corrosion agent recently announced offers interesting results and savings when added to steam and water line applications, maker says. In steam systems, it is reported this new chemical not only counteracts rust and its resulting corrosion in the boiler and boiler water, but also acts as a rust-proofing agent throughout the entire system. It is said that the results of this new chemical would seem to give to internal surfaces the same protection from rust and corrosion that paint and other protective materials give to external ones. Chemical is called Rust-buster No. 3. *Cannon Chemical Co, Inc, Everett, Mass.*

Air-Cooled Transformers

USE OF AIR-COOLED power-distribution transformers meets safety requirements and most always with material simplification in installation and with reduced initial and operating costs, it is claimed. Ability to place transformer near load center introduces additional economy by reducing heavy copper secondary runs, thereby improving voltage regulation and increasing operating efficiency. Line is constructed throughout

HOW TO BANISH THIS

Power wasting ghost!



Scale, the boiler room ghost, grows until boiler efficiency is impaired and shutdowns for cleaning and expensive repairs can no longer be avoided. The way to completely eliminate scale is to condition your boiler water in accordance with the most approved methods.

The Dearborn Way of Water Conditioning Assures High Efficiency

Dearborn Service is designed to fit the operating conditions prevailing in your own plant. The recommended treatment for you is balanced to give full protection against all of the conditions revealed by the water analysis and plant survey.

Boilers, Like Men, Have to Be Fed Well to Win

Dearborn Engineer is right at hand to work with you and to see to it that your boiler feedwater is conditioned to deliver full steaming efficiency. He continues to call regularly to insure maintenance of the operating procedure he recommends. If you are not a user of Dearborn service, drop us a line . . . we'll arrange to see you.

Dearborn Chemical Company
Dept. D, 310 S. Michigan Ave.
Chicago, Illinois

DEARBORN ENGINEER IS NEARBY TO HELP YOU

Dearborn

TRADE MARK REGISTERED

WATER TREATMENT AND ENGINEERING SERVICE

Sample Coal the "STURTEVANT WAY"... and cut out guesswork in your biggest expenditure

Coal is probably your largest single item of expense. You undoubtedly check its weight and O.K. bills for it, but how do you sample it to determine its actual B.T.U. value? What's the use in spending a lot of money for laboratory service if the coal samples submitted for analysis are not represented?

Sampling with the IMPROVED STURTEVANT AUTOMATIC COAL CRUSHER AND SAMPLER eliminates the notoriously hit-and-miss inaccurate results common to hand sampling. Instead, it provides a continuous system of sampling and crushing and makes samples available that are truly representative and accurate—an important advantage to consider today when plant efficiency must be maintained in spite of having to use coals, the quality of which varies considerably with each delivery into your bunkers. To know your B.T.U.'s exactly *at all times* is to be able to adjust your plant to attain best possible performance without danger of interrupted service. Economy, too, in the use of coal depends on knowing exactly what's in every ton of coal you buy. Get the most out of your biggest expenditure by sampling your coal the "STURTEVANT WAY."

because

- guesswork is eliminated
- absolute accuracy is assured
- results are truly representative
- sampling is simpler, faster, automatic and not dependent on the human element
- 32 out of 34 operations involved in hand sampling are eliminated.

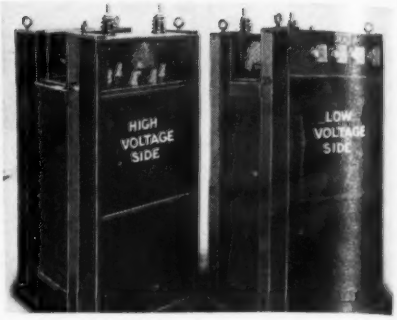
OPERATION AND CAPACITY

The STURTEVANT AUTOMATIC COAL CRUSHER AND SAMPLER reduces 3"coal samples to 8 mesh or finer at the rate of 1 ton per hour and at the same time automatically extracts an accurate, truly representative 5, 10 or 15% (as desired) sample of the whole, ready for laboratory analysis. The machine is available with belt or motor drive, requires 3 H.P. for operation and requires a floor space of only 3' 0" x 2' 0".

Write at once for Bulletin No. 85 "How to Sample Coal Automatically."

Sturtevant Mill Co.

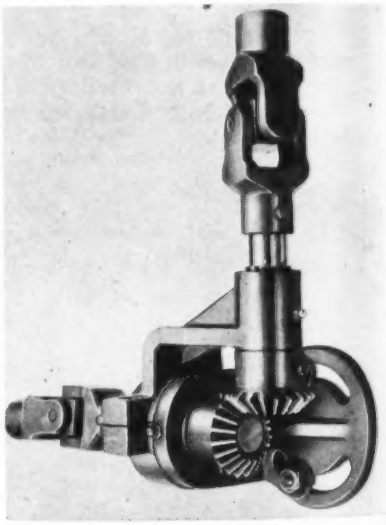
103 Clayton St., Dorchester, Boston, Mass.



with class B, heat-proof insulation—fiber glass, mica, asbestos and porcelain. Can be furnished up to 500 kva; in voltages to 4800 volts; single phase, 3 phase and Scott connected three to two or two to three phase in one unit. *Eisler Engineering Co,* 740-770 South 13*th St, Newark, N. J.*

Angle Drive

UNIVERSAL ANGLE DRIVE for operation of valves, skylights, ventilators, etc, designed for hand operation and capable of transmitting approximately one-half horsepower at speeds not exceeding 300 rpm. While one shaft remains fixed in either horizontal or vertical position, other may be rotated around



axis of fixed shaft through an angle of 180 deg and locked in any position within this range. After most convenient angle has been determined, device is securely locked by clamp but may be unlocked for further changes. Unit can be taken apart by removing two taper pins. *Payne Dean & Co. Laconia, N. H.*

Voltage Stabilizer

VOLTAGE STABILIZER provides constant output of 115 volts from circuits varying between 95 and 130 volts and is insensitive to load power factor. Completely self-protecting, machine will

STANDARD OIL ANNOUNCES

NEW Stanobar GREASE

For easier handling in grease guns ...longer life in anti-friction bearings

A war-bred grease for wartime jobs. Today's production pace demanded this new type grease. Longer hours of operation alone call for a more stable grease to resist heat and oxidation, while the need for more frequent lubrication of bearings makes an easily handled gun grease an asset.

Stanobar brings you both these advantages. It's a smooth (not fibrous) type grease. It contains inhibitors which reduce oxidation of both the soaps and oil in Stanobar. That means less cleaning of bearings and less labor and lubricant required to flush out old grease.

Stanobar resists thinning out when worked—that helps reduce leakage. It may also enable you to replace two or three grades of grease you are now using with this one grade of Stanobar.

Let a Standard Lubrication Engineer explain some of the other advantages of new Stanobar—and help you make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

How to service ball and roller bearings. Proper packing of bearings after inspection is highly important. Bearings equipped with pressure fittings are sometimes replaced dry and filled with a grease gun, but a careful, hand-packed grease job is well worth the little extra time it may take. The illustrations at the right point out some of the steps to take.

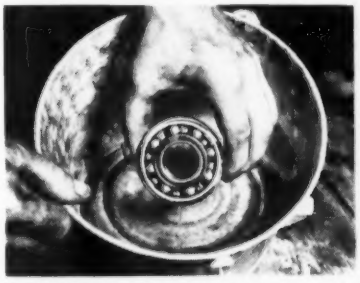
CHECK THESE ADVANTAGES OF NEW STANOBAR GREASE

- . . . Easily handled in grease gun or pressure system.
- . . . Resists thinning-out when worked.
- . . . Does not oxidize and form deposits.

OIL IS AMMUNITION . . . USE IT WISELY

Clean motor and bearing housing before removing bearing.

Remove bearing wash it in kerosene, and dry thoroughly with a clean cloth.



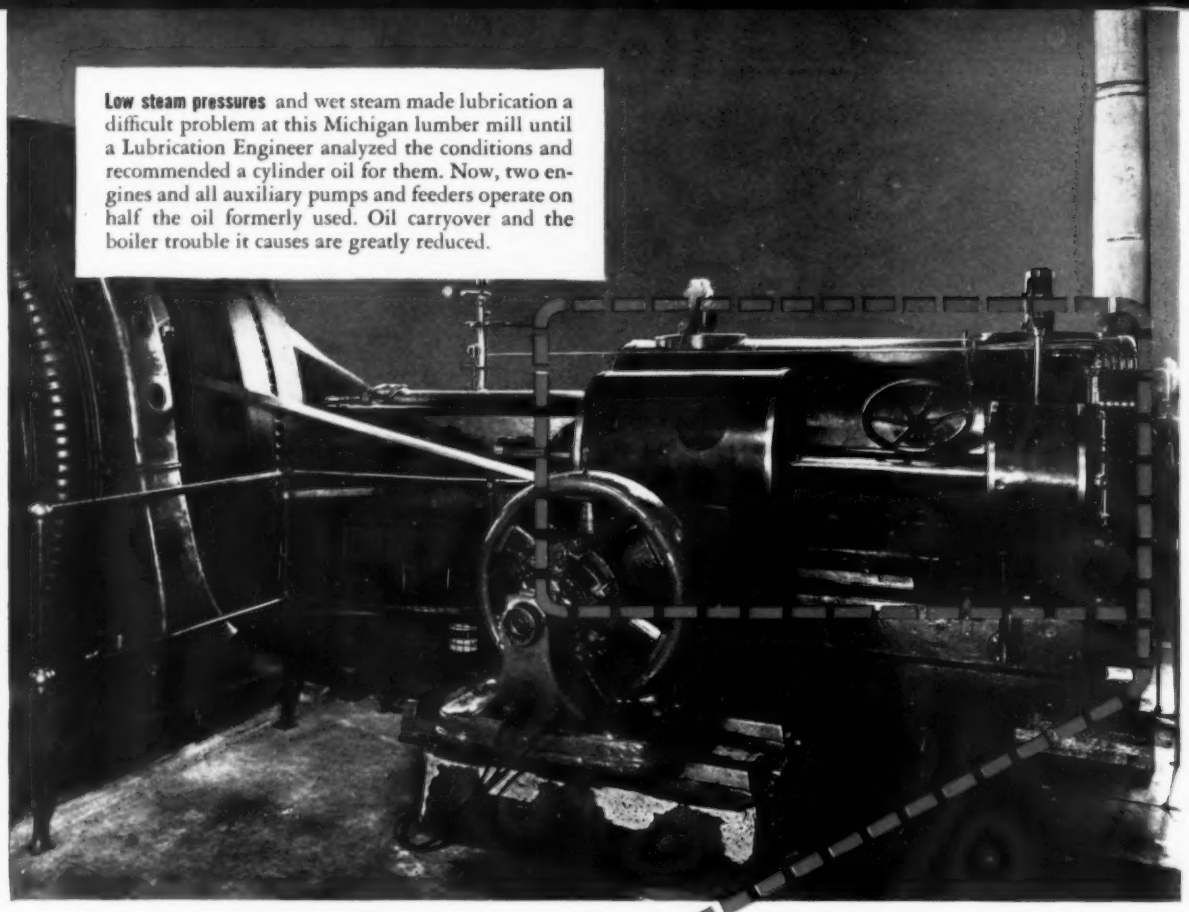
Dip bearing in a light lubricating oil. Allow excess to drain before repacking.

Put grease only in depression of spacer (both sides). Then spin one of the races, and wipe off excess grease thrown out. Replace the bearing. Do not put additional grease in the bearing housing.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

•LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRIC

...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION E



Low steam pressures and wet steam made lubrication a difficult problem at this Michigan lumber mill until a Lubrication Engineer analyzed the conditions and recommended a cylinder oil for them. Now, two engines and all auxiliary pumps and feeders operate on half the oil formerly used. Oil carryover and the boiler trouble it causes are greatly reduced.

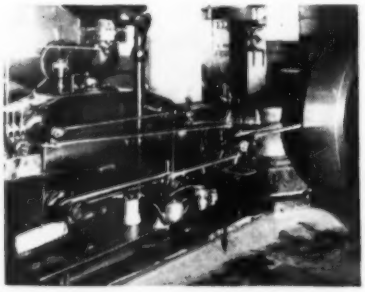
Assure needed power for war loads

THERE'S little stirring military action about the plants pictured here. But the extra power to produce the machines of war must come from plants just like these, and yours. That power must not fail for any reason—particularly not from improper care or lubrication, because it is so simple to make sure that lubrication is not the cause.

You can't make a better first step than to reexamine your whole problem of steam engine lubrication—your lubricants and lubricating methods. See where they might be affected by the new demands on equipment—the longer hours of operation, and heavier loads. Look at consumption records, for example. Increased consumption may indicate increased wear.

As a double check, let a Standard Lubrication Engineer work with you. He's helped many plants facing war power demands. He's had a chance to see where troubles strike first. He may have many helpful suggestions for you.

If you don't already know the Standard Oil Engineer in your locality, call the nearest Standard Oil (Indiana) office, or write 910 South Michigan Avenue, Chicago, Illinois, and ask to have a Lubrication Engineer stop at your plant.



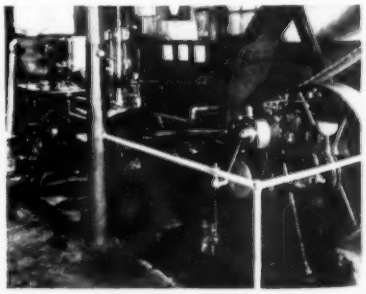
Since the last war when the 200 H.P. engine (above) was switched to a Standard steam cylinder oil, operation has been almost continuous, with little or no maintenance. The cylinder has never been rebored and rings have been replaced only once.

★ ★

STANDARD STEAM CYLINDER OILS

★ ★

Oil is Ammunition . . . Use it wisely

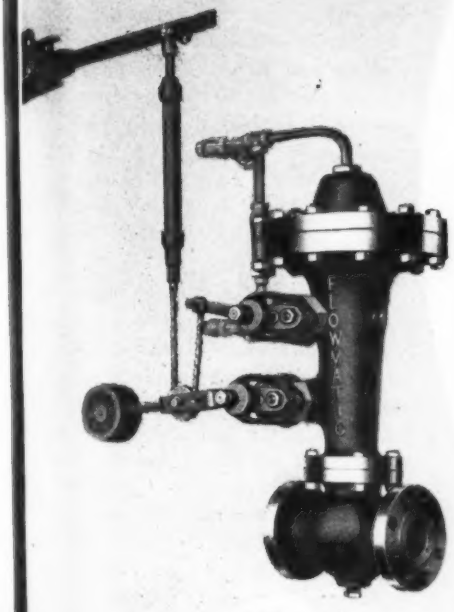


Millwork for defense housing is this plant's job. An analysis of steam pressures and loads, and a thorough check of feeds for adequate cylinder and valve lubrication led to a recommendation of Stanocyl Cylinder Oil. This has kept this engine free from all lubricating trouble.

STANDARD OIL COMPANY (INDIANA)

PRICE

IS WHAT YOU PAY
VALUE IS WHAT YOU
GET---



COPES Flowmatic, the steam-flow regulator, is designed to protect a boiler, not to meet a price. In first cost Flowmatic may cost you more dollars than any other regulator on the market. However, shrewd engineers and operators add up the savings and performance offered by Flowmatic and soon write off its price in a few months of service.

Over 800 boilers, Flowmatic protected, tell their story on performance—168 hours every week—even more conclusively than does the new edition of Book 429 which is yours for the asking.

NORTHERN EQUIPMENT CO. • *431 Grove Drive, Erie, Pa.*
FEED WATER REGULATORS • PUMP GOVERNORS • DIFFERENTIAL VALVES
LIQUID LEVEL CONTROLS • REDUCING VALVES AND DESUPERHEATERS
Branch Plants in Canada, England... Representatives Everywhere

OVER 60,000 COPES FEED WATER REGULATORS IN SERVICE

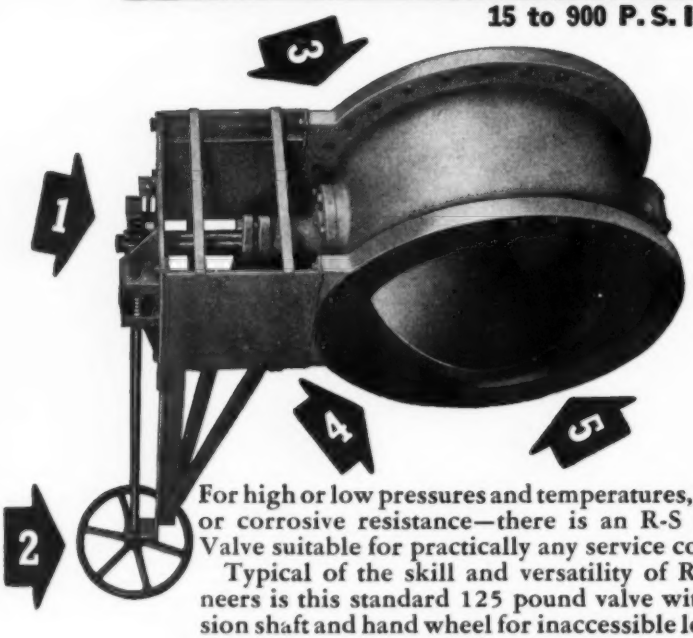
★ GET CLOSER LEVEL CONTROL WITH THE COPES FEEDS BOILER ACCORDING TO STEAM FLOW—AUTOMATICALLY FLOWMATIC ★ REGULATOR

Simplify

R-S QUALITY PRODUCTS SINCE 1903

Control and Shut-Off for Inaccessible Locations

15 to 900 P. S. I.

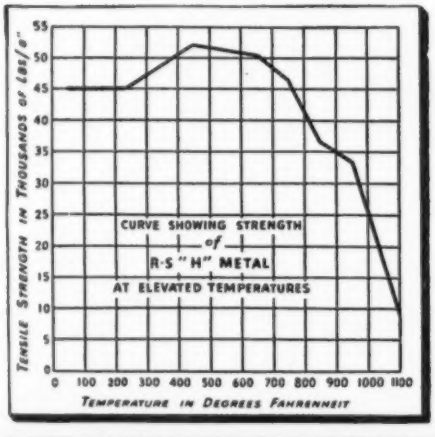


For high or low pressures and temperatures, abrasive or corrosive resistance—there is an R-S Butterfly Valve suitable for practically any service condition.

Typical of the skill and versatility of R-S Engineers is this standard 125 pound valve with extension shaft and hand wheel for inaccessible locations. Consider these outstanding features.

1. Oversize gear and worm.
2. Six hand wheel revolutions complete full vane movement.
3. Husky vane shaft mounted in grease-sealed stuffing box.
4. Body and vane can be cast of special R-S "A" or "Abrasive" metal for extra-long wear.
5. Beveled vane is precision machined—seats wedge-tight against valve body. Constructed to any A.S.M.E. dimensional standard. Sizes to 72-inches.

BUTTERFLY VALVE DIVISION
R-S PRODUCTS CORPORATION
4536 Germantown Ave. Philadelphia, Penna.



A SUBSTITUTE FOR STEEL!

R-S Engineers have developed special metals for resistance against heat, abrasion and corrosion. For example, R-S "H" Metal is an alloy semi-steel that machines like cast iron. Tensile up to 50,000 p.s.i. Withstands high pressures and penetration of steam and gases up to 1000°F. Stress relieved up to 1400°F.

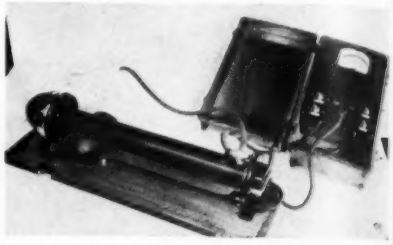
Request detailed information and Catalog No. 10-B.

R-S Streamlined BUTTERFLY VALVES

operate continuously throughout range from open circuit to short circuit without damage. Stabilizer can be applied wherever close voltage regulation is requisite to good operation. Ratings from 50 va to 5000 va are available. *General Electric Co, Schenectady, N. Y.*

Smoke Meter

PHOTOELECTRIC SMOKE METER, designed for diesel and other internal-combustion engines and furnaces, is portable and furnishes an objective indication of smoke density. One part of instrument is 18-in. tube with light source



on one end and photocell on the other. The second part comprises indicating instrument and controls, connected to first unit by cable. Meter is operated by alternating current or from 6-volt storage battery. Indicating instrument reads smoke density directly in percent. *Photovolt Corp, 95 Madison Avenue, New York, N. Y.*

Rotary Pump

ROTARY PUMP with improved removable liner helps conserve critical materials from which rotary pumps are usually made. Unit operates on "Bucket design" (swinging vane) principle but is constructed for easy removal of worn linings. Replacement operation involves only removing pump heads, driving out old liner and inserting new one. Normally, pump is back in operation in half an hour; no fitting is necessary. Pumps are made in capacities from 20 to 750 gpm, pressures up to 300 psi, are available for war-production plants with proper priority rating. *Blackmer Pump Co, Grand Rapids, Mich.*

Arc-Welding Electrode Holder

ARC-WELDING ELECTRODE HOLDER, designed for welding in power-plant maintenance, protects welder's eyes against flash and is said to eliminate work spoilage. Model F-1, made of high-conductivity copper alloy, has rated capacity of 200 amp, takes rods from smallest up to $\frac{1}{8}$ in., has mechanical or solder

MORE POWER with IRON FIREMAN P.S.* STOKERS

★ PNEUMATIC SPREADER

A Typical Example of Iron Fireman P.S. Performance

Boiler Output Up 41%... Steam Costs Down 30% in Georgia Plant

JOHN M. CLARK
President, Georgia Vitrified Brick & Clay Company

MORE steam, at one-third lower fuel costs, is being produced in the boiler plant of the Georgia Vitrified Brick and Clay Company, Campania, Ga., by Iron Fireman Pneumatic Spreader stoker firing.

Three years ago one Iron Fireman P. S. Stoker was installed to fire two boilers.

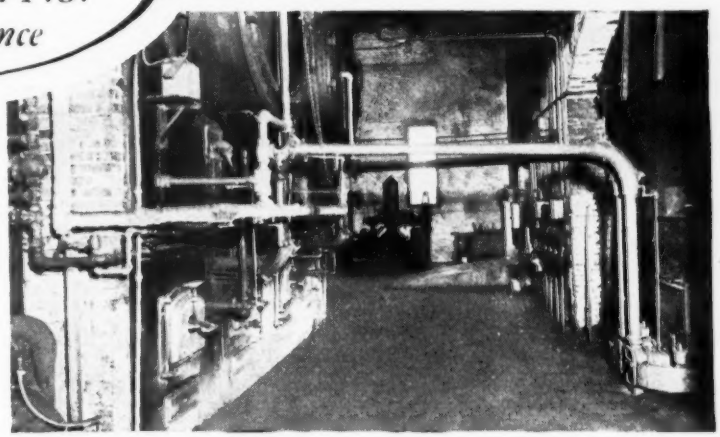
The boilers are H.R.T. welded type, with 1,470 sq. ft. of heating surface.

Boiler tests made before and after the modernization of the plant included these highlights:

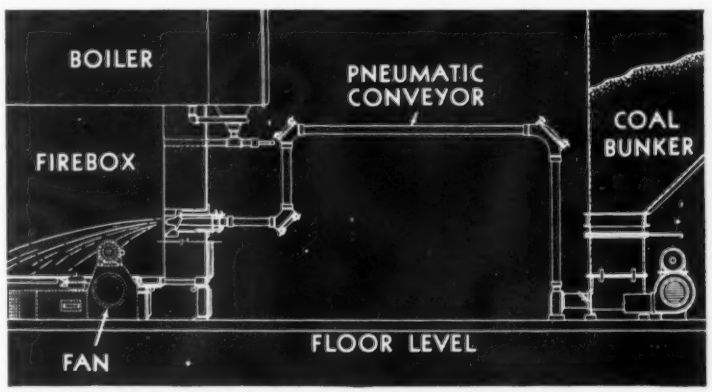
- Evaporation per pound of coal increased 21%.
- Maximum horsepower developed increased from 425 h.p. to 600 h.p., or 41%.
- Cost of 1,000 pounds of steam reduced from 31.2 cents to 22 cents, or a saving of 30%.

Free Book on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Manufacturing Company, 3501 West 106th Street, Cleveland, Ohio.



One Iron Fireman P. S. Stoker serving *two* boilers with its dual pneumatic conveying systems. One nozzle enters each boiler. The boilers were quickly adapted to Pneumatic Spreader firing which conveys steam size coal from the main coal bunker to a transfer housing where the coal is picked up by a stream of air and conveyed to the furnace and grates. In this installation no alterations were required of the boiler front except the cutting of two small openings for the nozzles.



Sketch showing how P. S. Bin-Fed model automatically conveys coal direct from main bin to boiler furnace.

IRON FIREMAN AUTOMATIC COAL STOKERS

• SAFETY & RELIEF VALVES • PRESSURE & VACUUM GAUGES • SPECIALTIES •

"300 SPECIALTIES FOR POWER PLANTS"...

And, to this complete line of safety appliances, the product development program of our Engineering Department continually adds new and improved devices. For the newest—to cope with increasingly high pressures and temperatures—look to Lonergan!

J. E. LONERGAN COMPANY
RACE AND SECOND STS.
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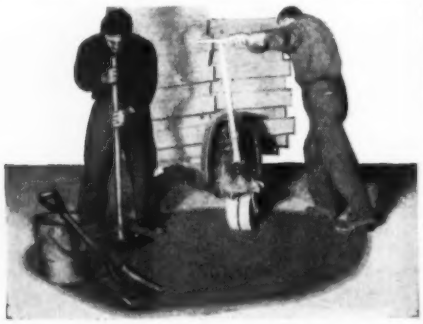
SIGN OF PROGRESSIVE ENGINEERING!

SINCE 1872

• SAFETY & RELIEF VALVES • PRESSURE & VACUUM GAUGES • SPECIALTIES •



PATCH FLOORS
. . . while Traffic Rolls

Here's a new, fast way to patch broken concrete without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

REQUEST DESCRIPTIVE FOLDER and Details of FREE TRIAL OFFER

INSTANT-USE
FLEXROCK CO., 2377 Manning St., Phila., Pa.

Make Your Overhead Valves SAFE And Easy to Reach---

Control from the Floor

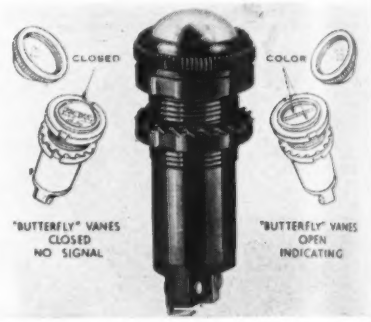
With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.

cable connections. Its slight weight and slim proportions enable welder to manipulate it easily in tight places, it is stated. *Jackson Products, Detroit, Mich.*

Light Signal

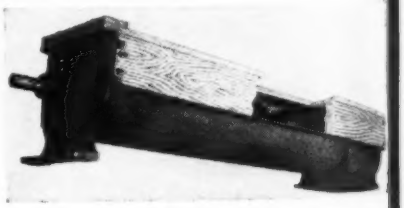
SIGNALLETTE LIGHT SIGNAL operates by fluorescent reflection of "black light" and shows signals dependably even in total darkness, manufacturer claims. Indication is free from glare in daylight as well as night. Signal carries transparent plastic cap which withstands



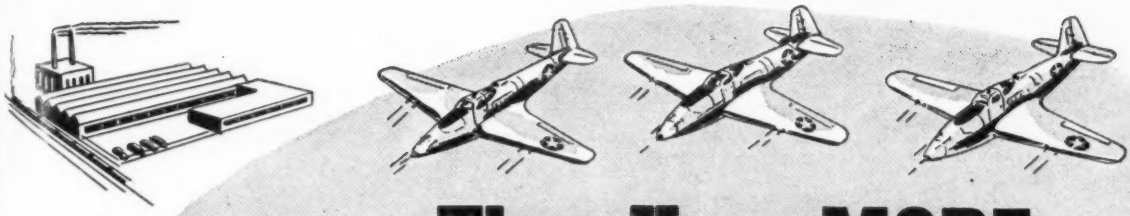
severe tests of shock or explosion and permits free penetration by ultra-violet rays. Signallette body houses a solenoid, armature of which is connected with the "butterfly" indication vanes by lever hookup. "Butterflies" are furnished in red, amber and green. *Littelfuse Inc, 4757 Ravenswood Ave, Chicago, Ill.*

Screw-Conveyor Trough

SCREW-CONVEYOR TROUGH comprises steel bottom with wooden sides and cover board, lag-screwed together to form tight enclosure for screw and material it conveys. Adaptable to all

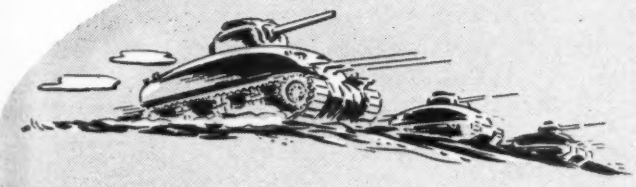


standard screw-conveyor fittings, new design will readily connect with existing steel troughs. Curved bottom will be steel no heavier than No. 10 gage. A substantial percentage of steel is saved compared to trough and cover plate heretofore furnished. *Link-Belt Co, 307 North Michigan Ave, Chicago, Ill.*

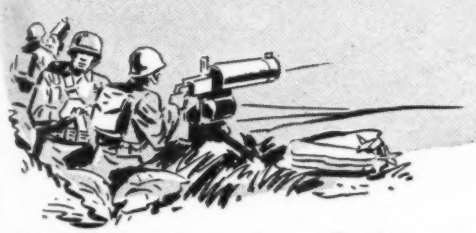


They Have MORE

Planes, Tanks, Guns, Ammunition...



because of this...



Engineering victory in production can be lost without an engineering victory over fire. Realizing this vital truth was a foremost factor in the selection of Cardox Fire Extinguishing Systems . . . in important plants producing military necessities, such as:

Electric Power	Ships
Aviation Engines	Chemicals
Aviation Carburetors	Foods
Airplane Parts	Building Material
Ordnance	Combat Boats
Armor Plate	Hot Strip Steel
Processed Fabric	Rubber Products
Tanks	Forgings
Tank Engines	Solvents
Engine Parts	Motor Fuel
Cold Strip Steel	Trainer Engines
Plastics	Airplanes

ENGINEERING PROBLEM: To be certain of operation *without interruption* by fire, engineers demanded: (1) extinguishing coverage for each specific hazard, (2) immediate extinguishment—and cooling, (3) no damage from the extinguishing medium, and (4) uniform extinguishing performance under all prevailing conditions—summer or winter.

ENGINEERING SOLUTION: War plant engineers found, in Cardox Fire Extinguishing Systems, the solution to each fire problem, large or small.

Engineered application provides a mass discharge of Cardox CO_2: in *pounds* of liquid for small fires, in *tons* for large ones. Added to fast, complete extinguishment is the uniform, enhanced cooling characteristic of Cardox CO_2—through a high yield of CO_2 snow.

As typical in extinguishment by carbon dioxide, there is no damage by the extinguishing medium. Yet, in summer or winter, Cardox CO_2 gives uniform performance—always ready, at 0° F. and 300 psi.

NO SHORTAGE HERE: Since Cardox makes *no* use of high pressure containers—deliveries on which are restricted by WPB Order M233—delivery of Cardox CO_2 is being made *without difficulties* to owners of Cardox Systems by the Cardox fleet of railway tank cars, trucks and trailers.

Today Cardox Fire Extinguishing Systems are making it possible for the Armed Forces of America and its allies to have MORE planes, guns, tanks, ammunition. If you would like to know more about performance of Cardox Systems, write on your company letterhead for Bulletin 943.

CARDOX CORPORATION
BELL BUILDING, CHICAGO, ILLINOIS
District Offices in New York • Washington • Detroit
Cleveland • Atlanta • Pittsburgh • San Francisco
Los Angeles • Seattle

. . . because of this: the Cardox Fire Extinguishing System, known to management and employees by this identifying Pushbutton Station.

It signals that the Cardox System will detect and extinguish fire through the automatically controlled system.

It means also that, by pushing a button, an employee can extinguish a fire—even before it is "picked up" by the fire detectors.

How CARDOX Protects War Production

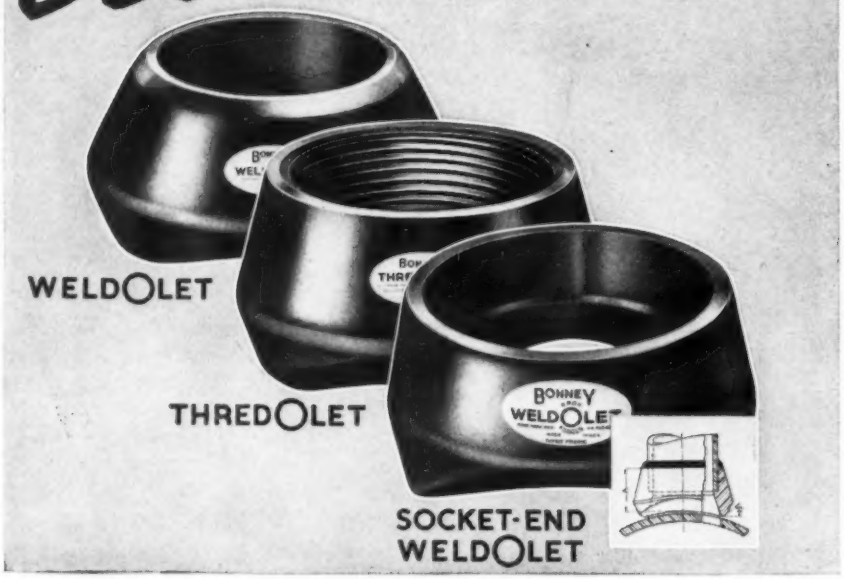
- Individual applications engineered to each hazard, all part of one complete system, discharge Cardox CO_2 in *mass* volume and high rate of flow that . . .
- Knocks out fire *immediately* by cold, inert carbon dioxide which cuts oxygen concentration below combustion requirements and cools fire zone below re-ignition temperature . . .
- Without damage from the extinguishing medium and without residue to delay production operations *after* extinguishment . . .
- Supplied instantly from a central Storage Unit maintaining as many tons as necessary of Cardox Liquid CO_2 at controlled low temperature and pressure for uniform extinguishing performance under all prevailing conditions, summer or winter, indoors or out.

MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

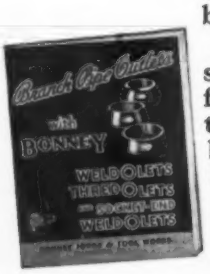
Economical



WELDOLETS, ThredOlets and Socket-End WeldOlets are economical because they cost no more—in many cases less—than any other type of fitting for making right-angle branch pipe outlets.

They are economical because they are installed by electric-arc or oxy-acetylene welding—because they reduce installation time by eliminating all cutting, threading, forming and fitting of the main line to install a tee.

They produce leakproof, right-angle welded branch pipe outlets of full pipe strength, either before or after erection of the main line. They reduce the weight of piping systems, eliminate the need for extra braces at the junction. Because of their wide, funnel-shaped intake aperture they improve flow conditions, reduce turbulence and friction to a minimum.



Made for all standard pipe sizes, they are suitable for every type of piping installation and for all commonly used pressures and temperatures. Stock fittings are of drop forged steel, but can be made on special order of Everdur, Monel, brass, wrought iron, Toncan Iron, etc.

Write for Bulletin WT31 giving full details of all their advantages.

Forged Fittings Division

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

WELDOLETS·

TRADE MARKS - REG. U. S. PAT. OFF.

THREDOLETS

Welded Outlets for Every Piping System

Feed Pumps

(*Continued from page 80*)

ing, (5) close drains when turbine becomes sufficiently heated, (6) open throttle gradually to increase speed.

To stop turbine, (1) trip overspeed by hand, (2) close throttle valve, (3) reset overspeed trip, (4) close exhaust valve and open turbine drains, (5) close water supply to turbine oil coolers.

Turbine Temperature Important

Turbine drives should not be started cold for the obvious reason that temperature changes from cold to those of operating conditions are of much greater magnitude than for pumps. Clearances are close and there is no flow of liquid to afford a measure of lubrication. For standby, turbines often are provided with means for passing a limited flow of steam at all times to keep the casing hot enough for immediate operation. Some larger turbines are kept rolling at low speed.

While such procedure is rare and more typical of turbine-generator usage, it should be remembered that feed pumps must dissipate some heat even at these low speeds and that recirculating valves should be kept open. This, incidentally, also fills the purpose of the warm-up valve which can be eliminated. In addition, a careful analysis of the lubricating problem under slow-speed operation is necessary. If the pump and turbine lubrication systems are served by direct-displacement gear oil pumps or if the bearings are supplied with oil rings, no further precautions are necessary. If, however, the pump bearings are lubricated by a so-called adhesive lubrication pumping ring, the oil pressure generated will be totally insufficient and an auxiliary oil pump should be provided for the idling operation.

For turbine drives, the overspeed trip must be set at a sufficiently high value to prevent interruption of the standby pump under emergency conditions. A careful analysis of the maximum speed at which the spare pump might have to operate discloses whether the speed is functionally safe for both turbine and pump, and determines proper setting for the overspeed device.

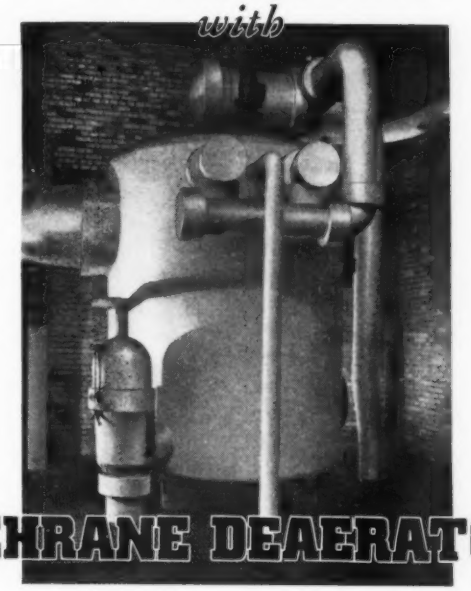
Automatic Controls

Automatic control of starting the spare pump eliminates the human factor, especially for modern boilers with little storage capacity where seconds

GUARDING POWER PLANTS

AGAINST CORROSION . . . . . IS IMPORTANT, TOO

with



COCHRANE DEAERATORS

WHILE danger from enemy attacks on power plants is an ever-possible threat and one against which unceasing vigilance is necessary, there are other ways in which power losses can be sustained . . . less spectacular attacks but in the aggregate affecting millions of boiler horse power. Corrosion from inadequately treated feedwater can be and is being prevented by the use of Cochrane Deaerators.

The Cochrane Down-Flow Principle, the most effective for complete deaeration ("zero oxygen") is the basis of Cochrane design; which properly anticipates the influence of all factors, such as inlet oxygen content, operating pressure and temperature, inlet water temperature, vent rate and tray efficiency at various flows. Cochrane Deaerators are available in designs suitable for any class of service and are guaranteed to remove the oxygen as required.

Write for a copy of Publication 2980

COCHRANE CORPORATION • 3123 N. 17th St., Phila., Pa.

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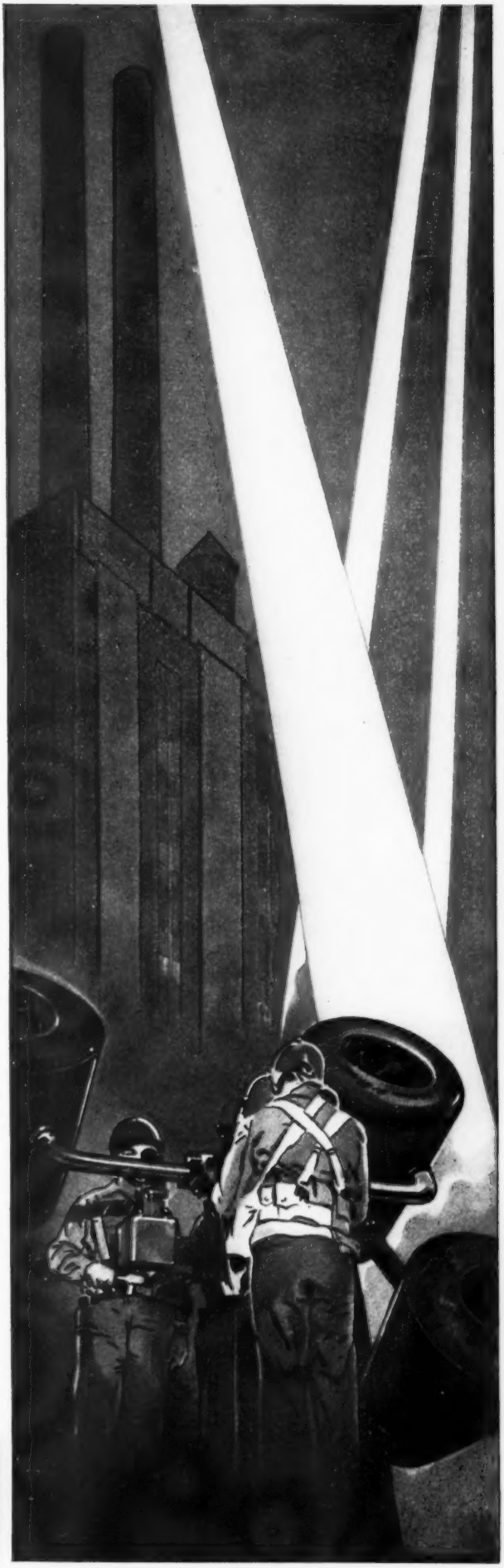
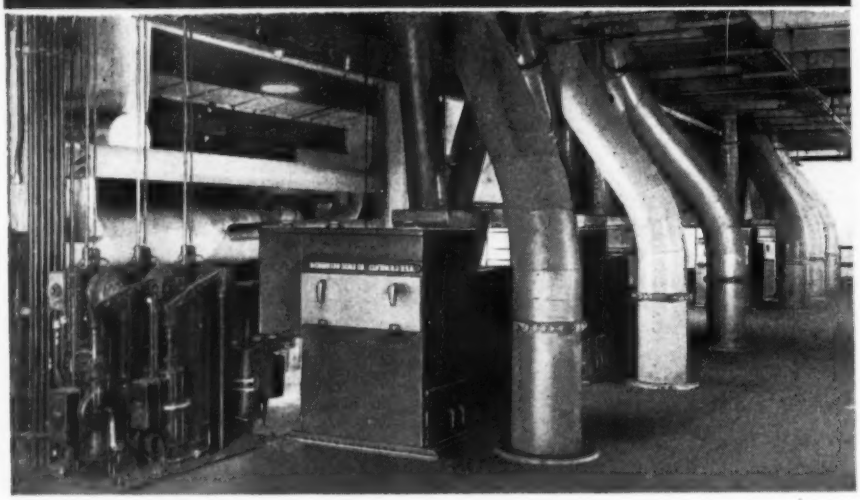
SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES



No. 1 *Aid to* MORE EFFICIENT BOILER OPERATION



BEFORE YOU CHECK on tubes, draft regulation, water intake, etc. to determine boiler efficiency, you must know how much coal each boiler consumes. Only then do you have a sound basis for computing steam costs—and taking steps to cut those costs.

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provide a record of coal burned by each boiler. Completely automatic—hence, labor-saving—they operate with continuous accuracy year after year, help get more steam from less coal. Richardson scales are dust-tight, easy to get at, need very little maintenance. Many types are available to operate under hoppers, bunkers, elevators or conveyors, and deliver to pulverizer or stoker or bunker. Elongated models increase bunker capacity by reducing dead storage, save bunker and building height, and eliminate need for extra conveying equipment.

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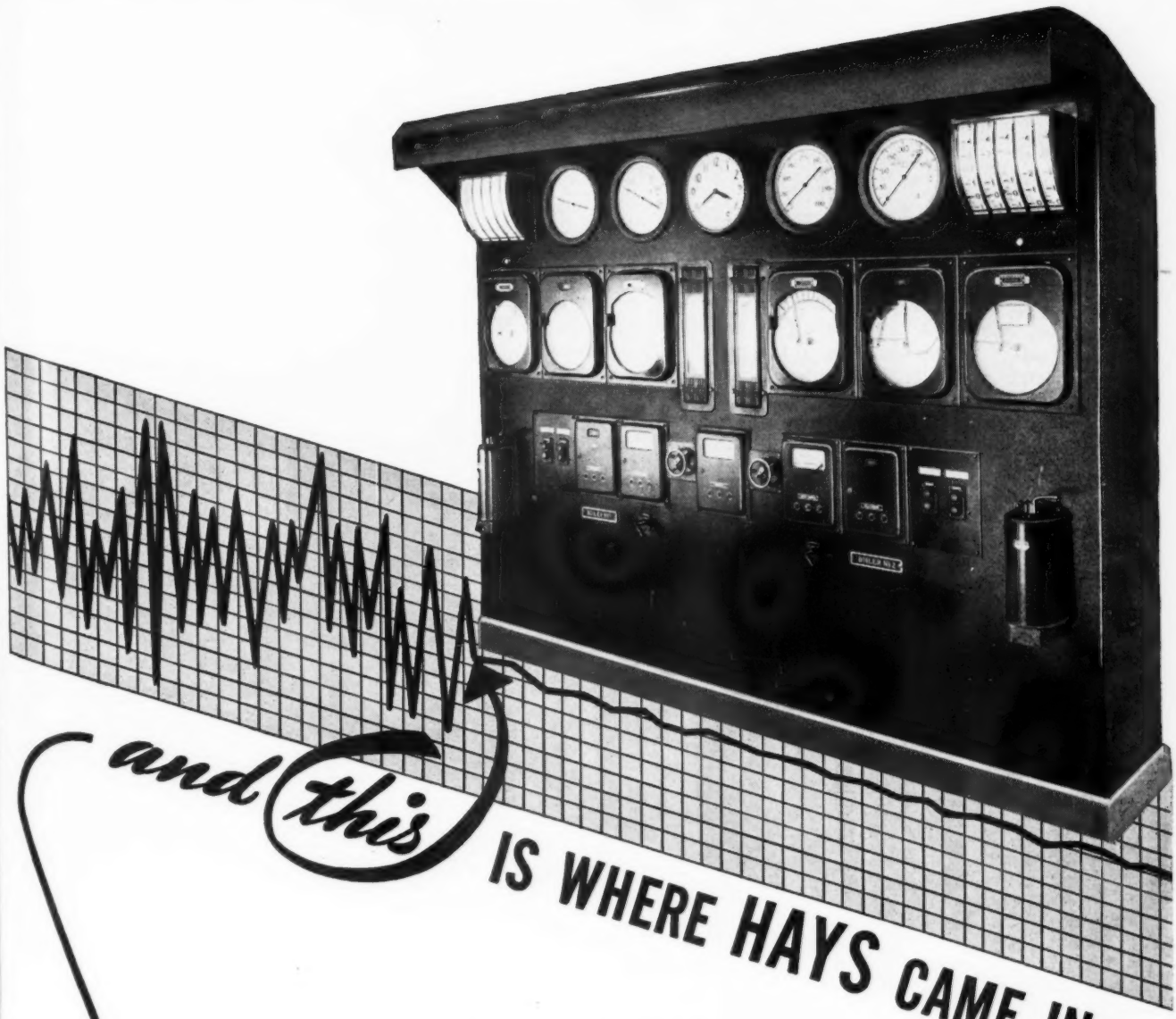
count. Such control can take its impulse from a number of sources. If the main pumps are electrically driven, the steam throttle valve on the standby pump turbine can be arranged to open on failure of power supply to the motors by a 2-position valve controlled by a manually reset solenoid pilot valve. In its shut position, the pilot valve keeps the turbine inlet valve closed as long as the electric circuit to the motors keeps the solenoid energized. On electric failure, the pilot valve opens the turbine throttle which remains open until manually reset. The medium which operates the steam inlet valve depends on local conditions. It may be compressed air, steam, high or medium pressure water or even oil under pressure supplied by a motor-driven oil pump operating on an independent electric circuit.

Because emergencies other than the loss of electric power may cause failure of the feedwater supply, such as seizing of a pump through overheating for example, it is advisable to provide a pressure-sensitive mechanism to break the energizing circuit of the solenoid pilot valve when the discharge header pressure drops below an established minimum, thus starting the spare boiler-feed pump turbine. Finally, the control must be insured against failure of the operating medium. This can be easily arranged by using a steam inlet valve of the spring opening type, so that the operating medium is used to keep it closed, not to open it.

Motor and Turbine Drive

Frequently, one or more of the boiler-feed pumps have dual drive, both motor and turbine. An ingenious control enables the turbine to pick up load if power to the motor fails. Turbine is kept up to temperature at all times by a small steam flow and is equipped with an adjustable-speed governor set at a speed slightly below that of the motor. Failure of motor power results in a fall-off of only a few rpm before the turbine picks up load, after which manual adjustment of the governor can be made to resume full capacity output. Remember, however, that dual drive protects against motor failure only, not against mechanical trouble with the pump.

Wherever automatic controls are employed, a manual-to-automatic selector arrangement should provide means of operating the turbine throttle by remote control. This selector allows the control to function automatically under proper emergency impulse or, when turned to "manual" position, enables the operator to obtain pilot-valve control directly



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Maintaining constant steam pressure, developing low cost steam, saving fuel, reducing man-hours are a few of the common sense results being achieved daily in industrial steam power plants by Hays Control.

These results are particularly desirable in an all-out drive for greater production of war material. And greater production starts at the source of power—power to drive the machines that turn out the tanks and planes and battle ships.

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It is impossible to incorporate in one bearing alloy all the physical characteristics needed to meet all possible working conditions. Average conditions call for good resistance to compression plus excellent anti-frictional qualities. Under extreme conditions some of the anti-friction qualities must be sacrificed to obtain either malleability or hardness. Insist on a bearing metal that has been "alloyed" for your particular application.

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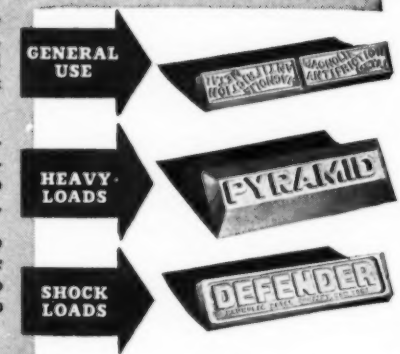
When bearings are subjected to heavy sustained pressures, such as in rolling-mill machinery, use lead-base Pyramid or tin base Power, hard metals which will not squeeze out.

For shock loads, which would crack the harder bearing metals, use lead-base Defender or tin-base Adamant, tough yet malleable metals. Internal combustion engines and trap rock crushers are typical applications.



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MAGNOLIA BEARING METALS

from the boiler-room instrument panel if such operation becomes desirable.

Turbine Lubrication

Lubrication of standby turbines must be positively assured. Normal supply from a gear pump driven from the turbine shaft may be found to provide insufficient pressure at low speed and for starting. A separately driven auxiliary oil pump for this purpose can be started more quickly than the main turbine by an arrangement such as Fig. 4. When the feed-pump-turbine throttle valve is opened by automatic or manual control, the auxiliary oil pump comes to speed in a few seconds. After the feed pump has come up to speed and its gear oil pump provides proper lubrication, the oil pressure is utilized to close a shutoff valve in the steam supply to the auxiliary oil pump unit.

In other arrangements, the turbine throttle is equipped with a time-delay mechanism to assure that the required supply of oil is available before the rotation begins. One method of accomplishing this is to use the oil pressure to lift the steam valve off its seat. With this system, the turbine steam supply is cut off if oil supply pressure fails for any reason.

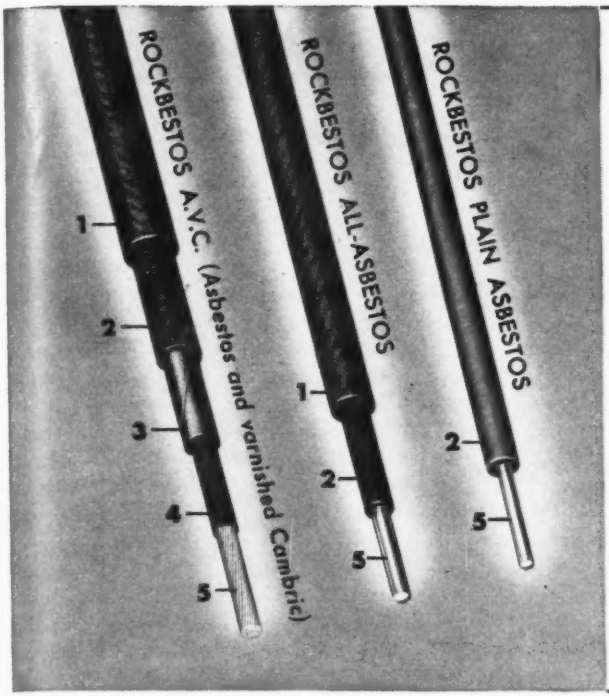
The oil pump arrangement of Fig. 4 can be used for a motor-driven auxiliary oil pump by substitution of a stop-start switch for the shutoff valve.

While not all boiler-feed pumps are equipped with water-cooled stuffing boxes and bearings, most of those equipped for automatic starting are in this class. On standby service, all water supply lines are normally closed on manual operation; the operator would normally open the water supply valves before starting the pump.

When automatic starting is provided at least three types of control are possible: (1) water may be supplied continuously while the pump is standing still, (2) service connections may be opened automatically, and (3) an operator can open water supply valves as quickly as possible after the pump has been started automatically.

Keeping water supply valves open at all times during standby, unquestionably the most completely safe procedure, wastes much water. There is also danger that an operator will, at some time or other, decide that the water waste is uncalled for and close the supply, failing to open the water valves at a critical moment.

If, however, a decision is made to supply cooling water to the standby pump at all times, water flow should not be throttled to too low quantity. Slime deposits, frequently present in



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122 wires, cables and cords, stemming from the three basic designs illustrated, have been developed by Rockbestos to give trouble-free performance under severe operating conditions in steel mills, power plants, chemical industries, etc. Send for catalog to see the rest.

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1. A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
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3. Lubricated varnished cambric for high-dielectric strength and added moisture resistance, protected from heat, flame, and oxidation by felted asbestos walls.
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5. The conductor is perfectly centered in helically applied insulation and will always remain so.

600 VOLT A.V.C. SWITCHBOARD WIRE—TABLE B

(Underwriters' Type AVB)

Sizes No. 18 to 4/0 A. W. G. with varnished cambric and felted asbestos insulation and gray, black, white or colored flameproof cotton braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is absolutely fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A. V. C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.

INDUSTRIAL HEATING CABLE—TABLE LH

No. 19 A. W. G. nickel-chromium wire insulated with .030" of felted asbestos and covered with 4/64" waterproof lead sheath.

This pliable cable distributes a mild heat evenly over a large area. Prevents freezing of water pipes, wet pipe sprinkler systems, etc. Keeps conveyor pipes for fuel oil, soap, varnish, ink, chocolate, etc., at temperatures that insure steady flow.

ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of A. V. C. Motor Lead Cable will complete the failure-proofing.

ALL-ASBESTOS FLEXIBLE CORD—TABLE CA

Sizes No. 10 to 18 A. W. G. with two or three conductors insulated with felted asbestos, covered with asbestos braid. Also in A. V. C. (asbestos and varnished cambric) constructions.

This heat-resisting flexible cord is ideal for high-wattage lighting units, floodlights, blueprint machines, apparatus, etc., which require a heavy duty, enduring cord. For moisture-resistant construction specify the A. V. C. type. Labeled cord with polarized conductors if desired.

600 VOLT A.V.C. BOILER ROOM WIRE—TABLE C

(Underwriters' Type AVA)

Sizes No. 18 to 4/0 A. W. G. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A. V. C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.

THERMOSTAT CONTROL WIRE—TABLE TC

Sizes No. 14, 16 and 18 A. W. G. in two to six conductors with 12½, 25 or 31 mil wall of felted asbestos insulation and cadmium plated steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal and temperature control systems. Its lifetime insulation and rugged steel armor will give you trouble-proof circuits.

600 VOLT ALL-ASBESTOS RHEOSTAT CABLE—TABLE R

(Underwriters' Type AI)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.

600 VOLT A.V.C. MOTOR LEAD CABLE—TABLE L

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric, heat-sealed varnished cambric insert, covered with heavy asbestos braid.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

600 VOLT A.V.C. CONTROL CABLE

In one to 19 conductors. Standard stranding A. W. G. No. 12—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

600 VOLT A.V.C. POWER CABLE—TABLE E

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid. Other constructions for service voltages to 8000.

Recommended for power circuits and hot spot wiring in or around boiler rooms, steam tunnels, soaking pits, tenter frames, glass plants, etc. The asbestos and heat-sealed varnished cambric construction has ample moisture resistance and withstands high temperatures.

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Fuller Rotary Compressors and Vacuum Pumps furnish such dependable and economical service, that of the hundreds now in operation, a great many have been installed on repeat orders.

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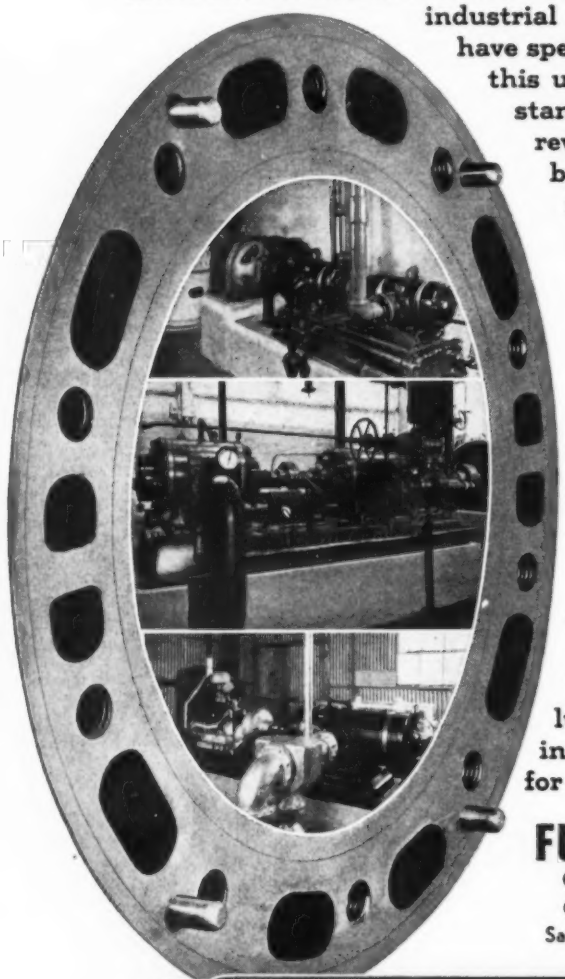

Simplicity makes for reliability and, one of the outstanding features of a Fuller is simplicity of design . . . only three moving parts—rotor, bearings, blades. Other features and advantages of Fuller Rotary Compressors and Vacuum Pumps are illustrated and described in Bulletin C-5. Write for a copy today.

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service water, tend to clog too-near-closed water valves and shut off flow altogether.

A simple automatic arrangement, Fig. 3, employs one or more spring-loaded diaphragm valves in the water-supply system, each having its pilot connection taken from the discharge side of the feed pump. The valves remain shut until opened by water pressure. On turbine-driven units, the pressure impulse can be taken from the steam connection to the turbine on the downstream side of the main steam valve.

For motor drive, solenoid-operated valves are substituted for the diaphragm valves in the water supply lines, the solenoid being actuated by the same power supply that drives the motor. In either arrangement, it is desirable to provide the water supply valves with a locking device to enable the operator to fix them in the open position while the pump remains in operation.

Even with completely automatic operation of the standby feed pump, it is wise not to lose sight of the fact that a power station is not entirely devoid of operators. A pump could run, in emergency, for perhaps five minutes without water supply to stuffng boxes and bearings and not suffer serious damage. Automatic starting is usually accompanied by some sort of signal or alarm that would give notice to personnel that pump operation needed checking.

Whatever the methods for assuring oil supply and cooling water to the standby feed pump, it is of paramount importance to establish a strict routine for carrying out the starting operation. If, for example, the service water connections are to be kept open at all times, red tags to that effect should be placed on the valve wheels. If the valves remain normally closed and are opened only on starting, the personnel should be carefully trained not to neglect this particular operation.

Editor's note: Further details on arrangement of spare pumps in boiler-feed systems will appear in May POWER.

■

Correction

In the article "How to Calculate Central Station Heat Balance, POWER, March 1943, the lower two bleed point pressures for full-load straight-condensing operation given in the caption at the bottom of page 91 were incurrectly taken from the author's original and should be 32.3 and 6.46 psi. Correct values appear in the computation sheet above and the entire computation of load and heat-rate values is otherwise properly carried out.

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New valves will be *harder* to get—even if you work directly for the war effort.

There are not sufficient materials for valves—or wear resisting parts. Allocation will reduce, still further, amounts valve manufacturers have been able to obtain for lower ratings. And control is directing the uses to which all valves are shipped.

Too few of us have the feel of this war—yet. But, it is our belief that those who need continued operation of valves will be well advised to adopt conservation and substitution right now—as part of the price loyal citizens pay for a victorious war. It is no whit smarter to try to find "angles" by which materials needed for active war can be diverted to our plants than it is for a commander in the field to withhold an order to fire—to save his own hide.

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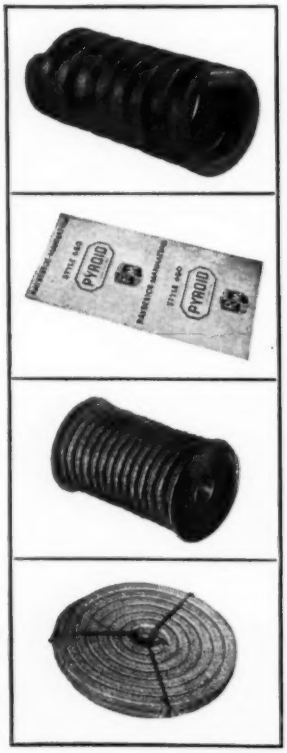

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Alabama—U. S. Eng. U. S. Courthouse & Customhouse, Mobile, plans constructing bldg, Tuscaloosa Co. Over $5,000,000.

California—U. S. Eng, 1209 8 St, Sacramento, plans constructing bldgs, Fresno Co. Over $2,000,000.

California—U. S. Eng, 1209 8 St, Sacramento, plans constructing imprvs, Fresno Co. Over $2,000,000.

California—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., plans by W D Peugh, 333 Montgomery St, San Francisco, bldg constructing, $4,450,000.

Florida—U. S. Eng, U. S. Courthouse & Post Office, Jacksonville plans constructing bldg, Orange Co. Over $1,000,000.

Florida—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., bids soon constructing imprvs, Indian River Co.

Fla., Jacksonville—City bids soon, constructing continuation, completion imprvs. $1,574,000. W E Sheddan, Jacksonville, city engr.

Illinois—Defense Plant Corp, 811 Vermont Ave N W, Wash., D. C., plans constructing addnl plant facilities. $11,000,000. Studebaker Corp, South Bend, Ind., will operate.

Illinois—Defense Plant Corp, 811 Vermont Ave N W, Wash., D. C., plans constructing plant, $5,000,000.

Illinois—Defense Plant Corp, 811 Vermont Ave, N W, Wash., D. C., will not construct plant, Madison Co. $13,000,000. Project definitely abandoned. Standard Oil Co of Indiana, Woodriver, Ill., and Whiting, Ind., operating-lessee.

Ill., Aurora—City defeated $150,000 bonds constructing imprvs. Over $2,000,000.

Indiana and Kentucky—Defense Plant Corp, 811 Vermont Ave N W, Wash., D. C., plans constructing plant facilities in Indiana and Kentucky. $1,300,000. Ken-Rad Tube & Lamp Corp, Owensboro, Ky., will operate.

Louisiana—U. S. Eng, U. S. Post Office & Courthouse, Vicksburg, Miss., plans constructing imprvs, Lincoln Parish. $1,036,926.

Maryland—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., plans constructing brick, granite bldg. $2,000,000.

Massachusetts—U. S. Eng, 31 St James Ave, Boston, plans expanding imprvs. Barnstable Co. Over $1,000,000.

Minn., St. Paul—Northern States Power Co, 401 Northern States Power Bldg, soon lets general contract constructing superstructure steam power plant exten, under High Bridge over Mississippi River at Smith Ave. Total est. $5,000,000.

Nebraska—U. S. Eng, 1709 Jackson St, Omaha, plans constructing bldg, Douglas Co. Under $5,000,000.

New Jersey, New York and Maryland—General Motors Corp, General Motors Bldg, Detroit, Mich., plans constructing addnl plant facilities in above states. $1,290,000. Defense Plant Corp will finance.

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"PULLS ITS OWN FREIGHT"

Longer than any Similar Small Valve

This is the biggest hunk of small valve you can get for your money *anywhere.* Standard seats and plugs are made tough enough to beat out any other small valve on the long pull . . . without repairs and replacements along the way. And if your service is tougher than the ordinary, then you can get List 960s with plugs and seats super-hardened by an exclusive Chapman process. Standardize on this long-lived forged steel gate valve for all lines from ¼" to 2" . . . for all pressures up to 800 lb. at 750° F., or up to 1500 lb. cold working pressure. Get in touch today, and get the small valve that goes in *to stay.*

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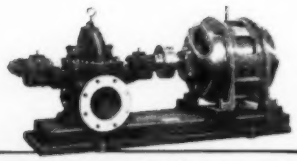

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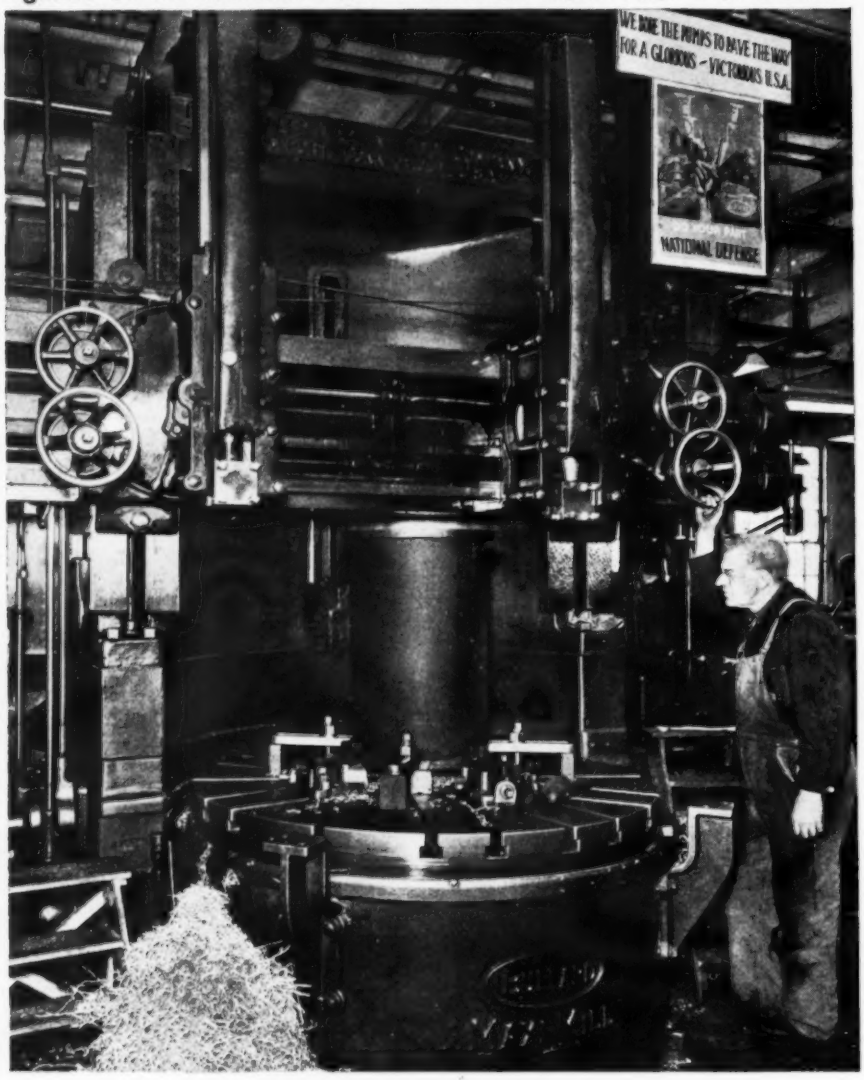


"BIS" MANNED THIS "BATTLE STATION" ALL THROUGH THE LAST WAR, TOO . . .

"Bis Gould has been a skilled pump maker — at the Warren Steam Pump Co., Inc.— for 40 years. All during World War I, "Bis" operated the same vertical boring mill (shown above), which, today, he is now using to help turn out Warren Pumps needed to help bring the present world tyrants to their knees.

There is no compromise in the quality and skill of Warren workers . . . no compromise in the quality of Warren pumps. Whether Warren Pumps are used for gruelling 24-hour duty in war plants . . or for active duty with the United States Navy, the Coast Guard, or the Merchant Marine, every piece of Warren equipment can be counted on for efficient, reliable, and economical performance.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

New Jersey—New Jersey Powder Co, 15 Broad St, New York, N. Y., plans constructing addnl plant bldgs $9,850,000. Defense Plant Corp will finance.

N. J., Garfield—Bids March 3, by Accurate Mfg Co, 44 Hepworth Pl, constructing brick boiler house. A Rigolo, 94 Plaget Ave, Clifton, archt.

Texas, Illinois and Indiana—War Emergency Pipelines, Inc, Beaumont, plans constructing 16-in. pipeline from point near Baytown, Tex. to Beaumont-Port Arthur area and from there extended as 20 in. line to Norris City, Ill. and Seymour, Ind., approx, 836 mi, $44,000,000. Defense Plant Corp will finance.

Texas, El Paso—Civil Aeronautics Admin, Box 1689, Fort Worth, plans constructing imprvs. $1,000,000.

Washington—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N W, Wash., D. C., plans constructing bldg, King Co. Over $1,000,000.

Contracts Let

Alabama—Reynolds Alloys Corp, Sheffield, awarded contract constructing addnl mfg bldgs, to Andrew Weston Co, 7 E 42 St, New York, N. Y. Est $3,500,000. Federally financed. W J Knight & Co, Wainright Bldg, St. Louis, Mo., engrs.

Arkansas—U. S. Eng, 300 Bway, Little Rock, awarded contract constructing imprvs, utilities, etc, Garland Co, to R B Potashnick, 1347 N Pacific St, Cape Girardeau, Mo. Est over $1,000,000.

California—Standard Oil Co of California, 605 W Olympic St, Los Angeles, awarded contract constructing plant, to Bechtel-McCone-Parsons Corp, 601 W 5 St, Los Angeles, $6,200,000. Federally financed.

California—U. S. Eng, 1209 8 St, Sacramento, awarded contract constructing addnl imprvs, Contra Costa Co, to Piazza & Huntley, Larsen Bros & Harms Bros, Route 4, Box 2220, Sacramento, Est between $500,000-$1,000,000.

California—U. S. Eng, 1209 8 St, Sacramento, awarded contract constructing imprvs, appurtenant facilities, Contra Costa Co, to Piazza & Huntley, Larsen Bros, and Harms Bros, Stockton Blvd, Sacramento, $500,000-$1,000,000.

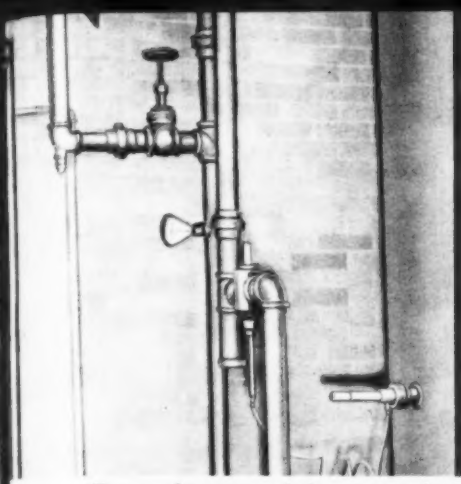
California—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., awarded contract constructing bldg addn, to Haddock-Engineers, Inc, P O Box 569, Oceanside, approx $4,000,000. C Beelman, 1019 Union Bank Bldg, Los Angeles, archt.

California—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., awarded contract constructing addnl facilities, S A 1, NOY 5440, to Macco Constr Co, 815 Paramount Blvd, Clearwater, $7,570,000.

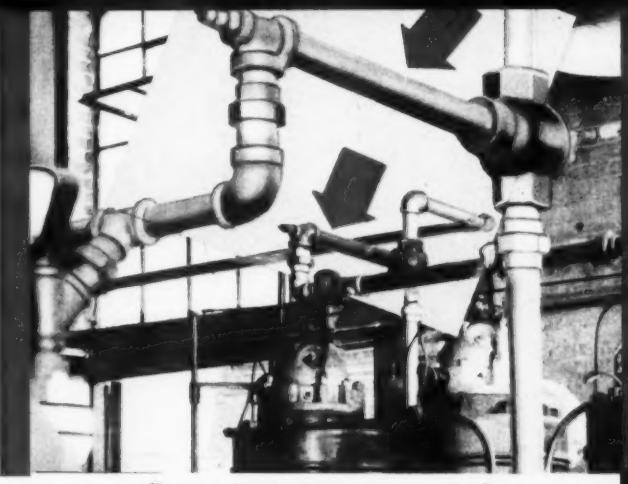
Florida—U. S. Eng, U. S. Courthouse & Post Office, Jacksonville, awarded contract excavating concrete work, underground storage tanks, pipe work, valves, fittings, pump house superstructure, Palm Beach Co, to The Murphy Constr Co, Clare Ave, West Palm Beach, under $50,000.

Florida—U. S. Eng, U. S. Courthouse & Post Office, Jacksonville, awarded contract constructing steam dist sys, Inv NEG-DH-43-8, Volusia Co, to Paul Smith Constr Co, 310 N Rome Ave, Tampa, less than $50,000.

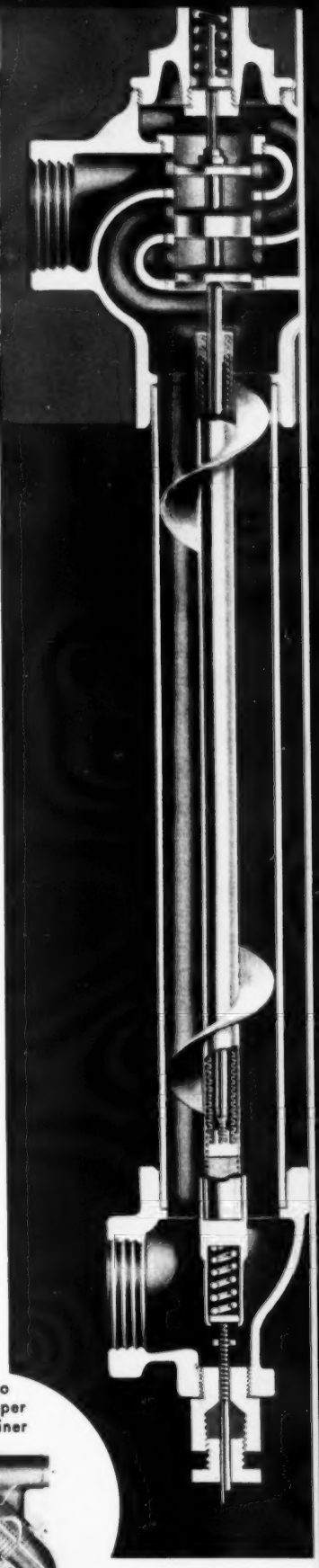
Georgia—U. S. Eng, Post Office Bldg, Savannah, awarded contract constructing ground storage reservoir, pumphouse, motor house, piping equip, etc. Thomas Co, to A S Wikstrom, Mobile, Ala., under $50,000.



For washroom and shower service.



For engine jacket water control.



Save with SARCO WATER BLENDERS

Here is a simple, sturdy thermostatic mixing valve of many uses.

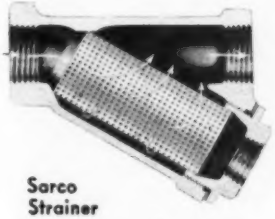
It will mix hot and cold water to provide blended water at any desired constant temperature. When used in connection with gang showers or group wash basins, it preserves hot water storage and will often make unnecessary the acquisition of additional heater capacity.

It brings tempered wash water right to the point of use in dairies, packing houses, or sheet mills. It provides accurate proportioning control for photographic and X-ray film washing.

Used to recirculate a varying portion of the cooling water, it saves water and lubricating oil and protects Diesel engines, compressors, or condensers. On brine unit coolers, it provides an accurate, compact and inexpensive temperature control.

A special type is available also for submerged heating coils and tankless water heaters connected to heating boilers in large or small buildings, to prevent scalding hot water reaching bath room fixtures. Catalog 700 and 800.

PROTECT expensive equipment from scale or dirt in pipe lines



Sarco Strainer

Sarco Self Cleaning Strainers are effective insurance against damage to delicate mechanisms due to dirt or scale carried in pipe lines. They cost little, are inserted like a coupling, are cleaned in a jiffy by blowing through.

Sarco Scraper Strainer

With SARCO Strainers

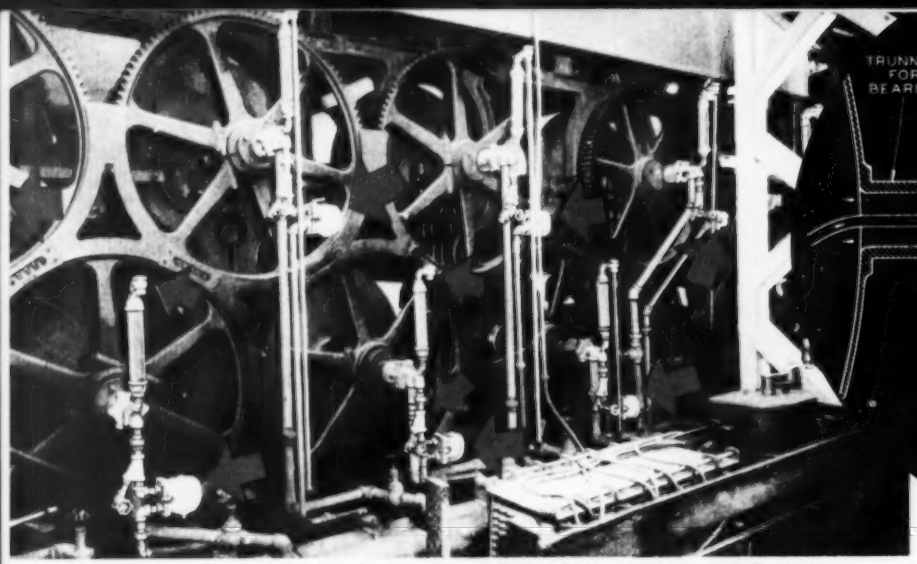
Sizes range from 1/4" up to 8" for all pressures and with screens suitable for steam, water, oil, gas, brine, ammonia and other chemicals. Scraper strainers available for hand or motor operation. Catalog No. 1200.

SARCO Saves Steam

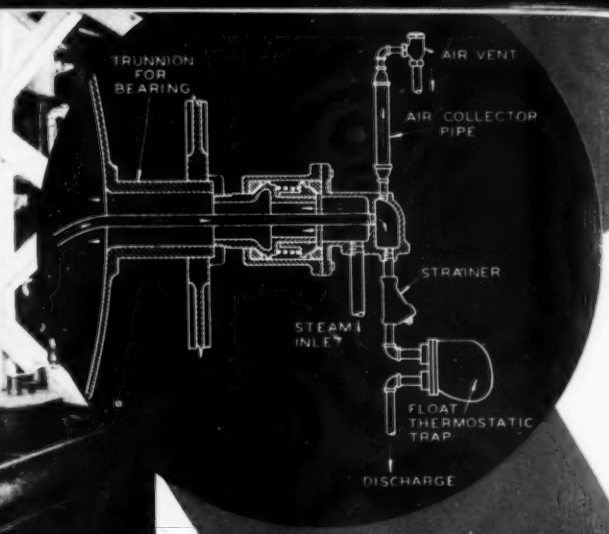
SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTA

SARCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK

Represented in Principal Cities



o Draining System on No. 1 paper machine at Burrows Paper Corporation, Little Falls, N. Y.



Sarco Draining System as installed on condensate discharge of each cylinder.

SOLVED—

a difficult draining problem

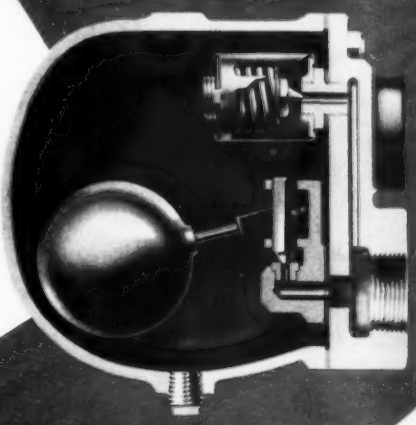
There are many good steam traps, but there is no universal trap capable of handling efficiently all the complex condensate drainage problems in industry.

SARCO is in a unique position to help with the hard ones because, making four distinct types, we can select the one best suited for each application.

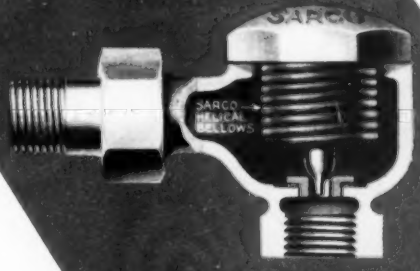
Take, for example, the drying cylinders on paper machines. Condensate, air and gases must be removed while these rolls revolve. The trap must be fast, capable of continuous discharge; it must vent air automatically—all without disturbing the steam pressure upon which roll surface temperature depends.

President Burrows of Burrows Paper Corp., Little Falls, N. Y., had tried many different traps before the Sarco representative made for him the simple hook-up shown above on his No. 1 machine. Now he says: "You have made the plant go like clockwork ".

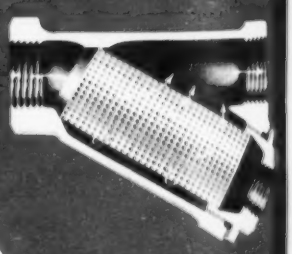
Sarco has done equally well with Sarco Float-Thermostatic traps on the revolving rolls of "dry cans" in textile mills, carbon paper coating machines, and roll ironers in laundries. Ask for Catalog 450.



Sarco Float-Thermostatic Steam Trap for rapid condensate removal from rotating cylinders. Integral thermostatic air vent prevents air binding.



Sarco Thermostatic Air Vent, type S-66, removes air and gas rapidly and completely.



Sarco Pipe Line Strainer, type SB, protects steam traps from dirt and scale.

Sarco Inverted Bucket Steam Traps are available for general application at pressures from 10—900 lbs., and for superheat. Preferred for supply lines to engines, turbines, and pumps, in refineries, laundries and for other hard service where intermittent discharge is permissible. Catalog No. 350.

Sarco Thermostatic Traps are the leaders for individual trapping of all types of process equipment and their supply lines. Preserve more useful heat than any other type. Available in sizes ½" to 2" for pressures 0 — 250 lbs. Catalog 250.

SARCO Saves Steam

tCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

Represented in Principal Cities

STEEL TUBES THAT MEET THE EXTRA *Demands* OF WARTIME SERVICE

THE *extra* margin of safety and strength so vital to modern high-temperature, high-pressure service is adequately provided in Globe Boiler and Pressure Tubes. Under the severe conditions of wartime service, Globe Tubes are proving the value of extra precautions taken in their manufacture.

In war production industries, power plants...in fighting, transport and merchant ships...in locomotives and other power units... Globe Boiler and Pressure Tubes are meeting extra demands of service.

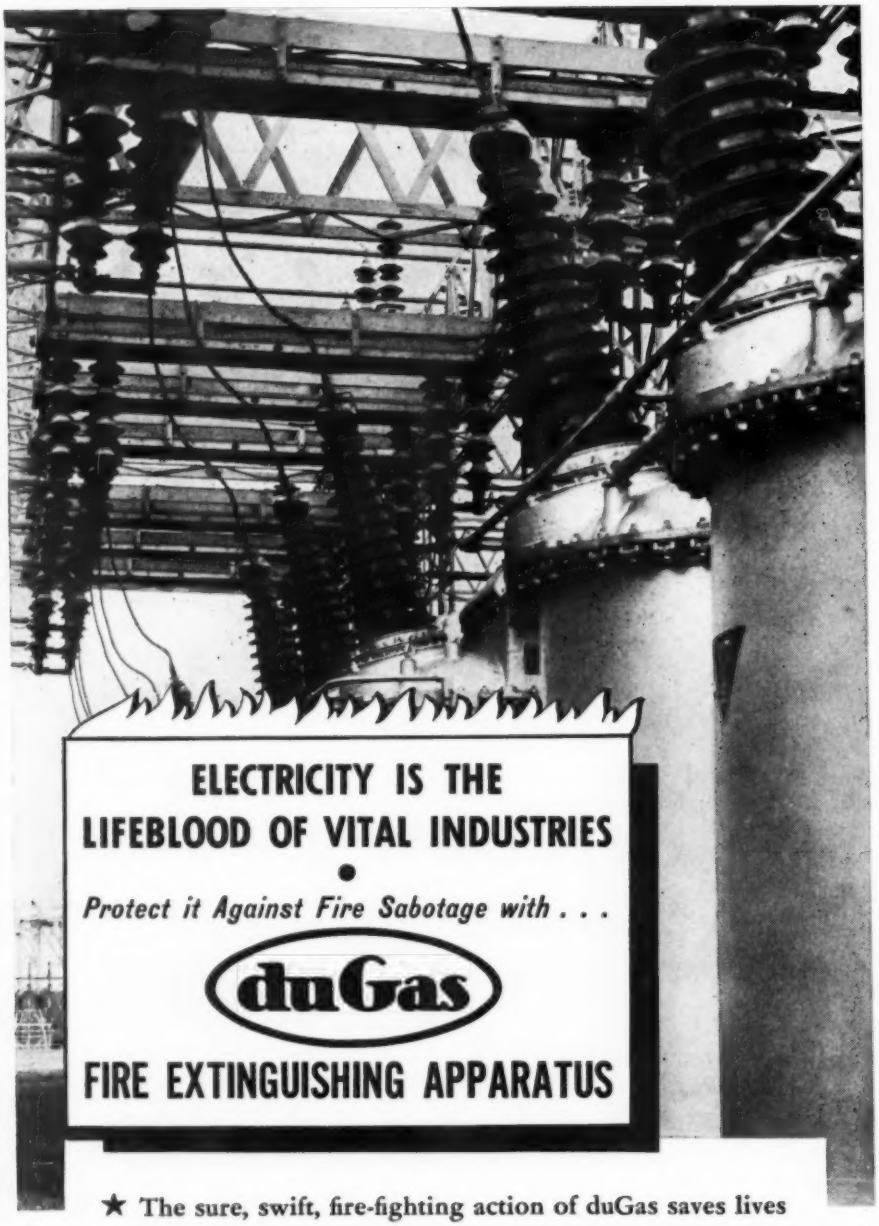
Globe mechanical tubing serves many critical needs in aircraft construction. Globe engineers can help you to select tubes with the exact characteristics you require—feel free to consult them. Their service is yours for the asking.

GLOBE TUBES

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES
★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL *Tubes*

GLOBE STEEL TUBES CO., *Milwaukee, Wisconsin, U.S.A.*


ELECTRICITY IS THE
LIFEBLOOD OF VITAL INDUSTRIES
Protect it Against Fire Sabotage with . . .
duGas
FIRE EXTINGUISHING APPARATUS

★ The sure, swift, fire-fighting action of duGas saves lives and valuable equipment. By cutting priceless minutes off the extinguishing period, it often keeps the flow of vital power on its way. DuGas stands guard today for utilities in many parts of the country.* It is a non-conductor, safe to use around electrical equipment.

ALWAYS READY—DuGas will not cake, harden, freeze, evaporate or deteriorate. Not affected by dampness. No toxic fumes. Particularly effective on fires involving inflammable liquids and gases.

* Names on request

AVAILABLE IN 16 AND 30 LB. HAND EXTINGUISHERS . . . 150 AND 350 LB. WHEELED ENGINES

Write for the story of duGas

DUGAS ENGINEERING CORPORATION • MARINETTE, WISCONSIN

Owned and Operated by
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Represented in Principal Cities

DUGAS FIRE EXTINGUISHING APPARATUS IS APPROVED BY UNDERWRITERS' LABORATORIES, FACTORY MUTUAL LABORATORIES

Power Lines

(*Continued from page* 134)

and Council connections, he was also president of the **Multiple V-Belt Drive Association.**

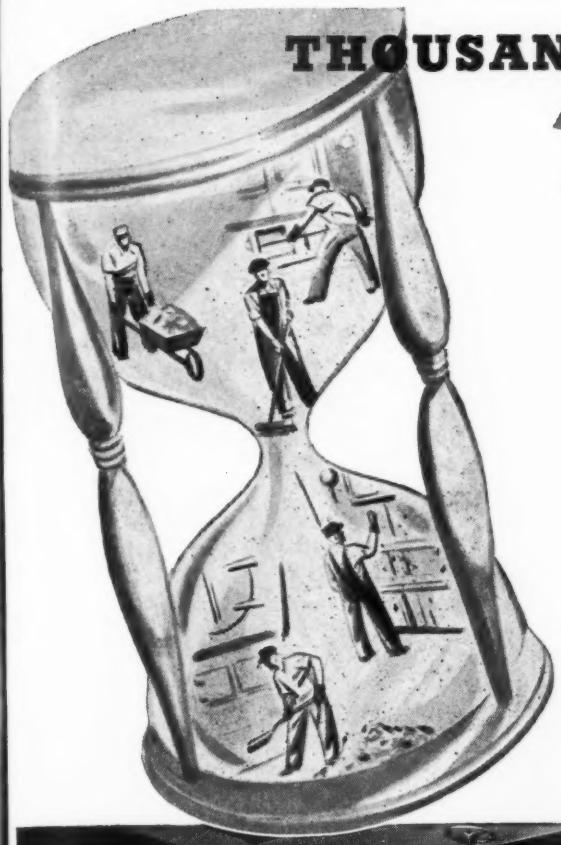
Mason Hulett, of the **Farrell-Birmingham Co** of Ansonia, Conn, and Buffalo, N. Y., died suddenly Feb 7 in Washington, D. C. Mr Hulett was widely known throughout the gear industry, having been connected with the New York office of the company for the past nine years as sales engineer and consultant on gears.

Melville B Chase, a power and lighting engineer for eighteen years with the **Beverly Gas & Electric Co,** Beverly, Mass., died at his home Feb 26 at the age of 70. He was a native of Vincennes, Ind., but had lived in Nahant, Mass., for over thirty years. For several years he was employed by the General Electric Co in Lynn, Mass., and was a member of the American Institute of Electrical Engineers.

Stanton Hertz, vice-president and assistant to the president of the **Copperweld Steel Co,** Glassport, Pa., lost his life in a fire on Saturday, Feb 27, 1943. He began his career with Copperweld in 1921 and served successively as chief engineer at the New York office, general manager of sales, and vice-president.

William E Foss, 64, a stationary engineer, formerly employed by the Peabody, Mass., Electric Light Department, died Feb 25.

Charles T Main, 87, nationally known consultant in power plants, mill and hydroelectric engineering, died at Winchester, Mass., March 6. Mr Main was a past president of the American Society of Mechanical Engineers, and the American Institute of Consulting Engineers. In his early career Mr Main was connected with Pacific Mills, where he was instrumental in rebuilding the factory and installing new steam and hydro facilities. From 1893 he was a partner in the firm of Dean & Main, Boston. The business was continued under his own name and incorporated in 1926. Mr Main continued in practice until his final illness. His notable career included much consultation on public utility, industrial and governmental work.



THOUSANDS OF BOILER-ROOM *Man hours Saved*

FOR WARTIME PRODUCTION

In scores of industrial plants, Cleaver-Brooks Steam Generators have saved thousands of boiler room man-hours, because these modern oil-fired units, equipped with automatic controls, do not require full time attention and their clean, smokeless operation reduces to a minimum the usual labor time incidental to flue cleaning, stoking fires, wheeling ashes, cleaning the boiler room and other maintenance.

The Cleaver-Brooks Steam Generator offers other basic advantages:

—high thermal efficiency — no less than 80% guaranteed.

—compact "packaged" construction saves space.

—clean — no smoke, no ashes, no clinkers — a kitchen-clean boiler room at all times.

—four-pass, down-draft construction gets all possible heat from fuel.

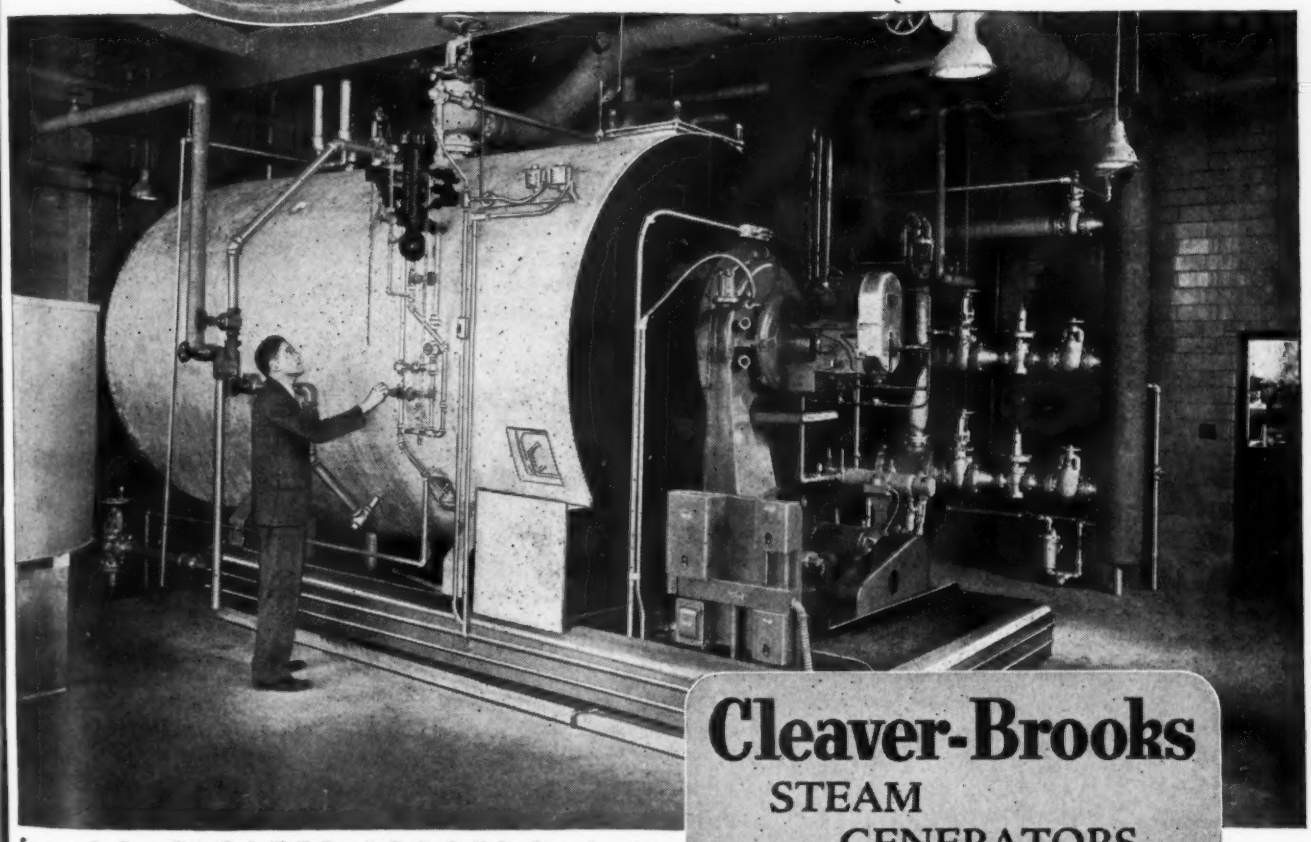
—positive blower air supply eliminates high, costly stack.

—performance-tested, fully assembled, by manufacturer.

—built by one company — Cleaver-Brooks, one centralized responsibility.

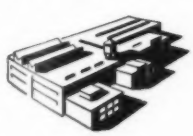
Whatever your present or future need for steam—within the range of capacity of a single installation (20 to 500 HP.—pressures 15 to 200 lbs.) or that of a battery of Cleaver-Brooks Steam Generators, secure full information now in anticipation of the time when normal conditions return.

CLEAVER-BROOKS COMPANY, 5109 N. 33rd St., Milwaukee, Wis., U.S.A.



Cleaver-Brooks
STEAM GENERATORS

Served By **CLEAVER-BROOKS** *Products*



Factory

Farm

Highway

Institution

Military

Analyze BOILER WATER this Easy, Quick Way!

The new Taylor Water Analyzer is a sturdy outfit especially designed for speedy and accurate determination of the ammonia content and pH of condensate . . . the latter generally acknowledged as one of the most difficult pH determinations. The CO_2 and ammonia content must be known when total solids are determined by conductance measurements, since these dissolved gases may contribute as great a conductivity as that representing the dissolved solids. Now, you may quickly and accurately determine both pH and ammonia content of condensate, as well as silica, total iron, etc., in boiler water, in a few minutes by using the Taylor Water Analyzer!

Complete with 1 slide...$18.00
Extra slides, each..... 8.00
F.O.B., Baltimore

All Taylor color standards carry AN UNLIMITED GUARANTEE AGAINST FADING!

Get This Booklet

See your dealer or write direct for booklet "Modern pH and Chlorine Control" — a factual, informative booklet that you will find extremely useful.

W. A. TAYLOR AND CO.
YORK & ROGERS FORGE RDS. • BALTO. MD.

Arthur C Flory, one of the best known steam engineers in the country, died March 1 at his home, Milwaukee, Wis. For 24 years he had been manager of the **Allis-Chalmers Mfg Co's** steam turbine department. Upon the completion of his education as mechanical engineer at Lehigh University in 1905, he joined the Allis-Chalmers organization. He became manager of the steam turbine dept in 1919. Mr Flory was a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the Milwaukee Engineering Society, of which he was the former president.

Martin Schiff, chief engineer of the **Century Electric Co,** St. Louis, died Feb 16. He joined Century in 1933, prior to which he was test engineer at the Diehl Mfg Co, Elizabeth, N. J. Mr Schiff was mentioned in **"Who's Who in Engineering"**, 5th Edition.

John G Barry, 75, honorary vice president of the **General Electric Co,** died March 4. He had retired as senior vice president of the company on July 1, 1935, after more than 45 years of active service.

✪ ✪ ✪

George Rice, chief engineer of the Pontiac, R. I., plant of Fruit of the Loom, Inc., has left that post to become master mechanic at the Kenyon, R. I. Piece & Dye Works. . . . The **Society of Sigma Xi** installed a chapter at the **Polytechnic Institute of Brooklyn,** March 25, 1943. A public address was given by **Dr Saul Dushman,** assistant director of the General Electric Research Laboratory. . . . "Plant Records and Power Costs" were discussed by **George M Diebold,** chief engineer of the F N Burt Co, and past president of the **National Association of Power Engineers,** before Keystone 16 in the clubrooms, Buffalo, N. Y., February 27. . . . **C L Cummins,** founder-president of the Cummins Engine Co of Columbus, Ind., has been appointed **executive consultant on deisel engine production** to the War Production Board at Washington, D. C. Appointment of Mr Cummins at this newly created post is the direct outgrowth of a conference held recently in Washington, at which all of the principal builders of all categories of diesel engines used in the war effort were represented. **Mr Cummins was a unanimous choice** because of his close association with the diesel industry for more than a quarter of a century of its development.

In Turbine Oil,

IT IS THE
CONTAMINATION
AND
IMPURITIES
that cause
TROUBLE!

So why worry about the oil?

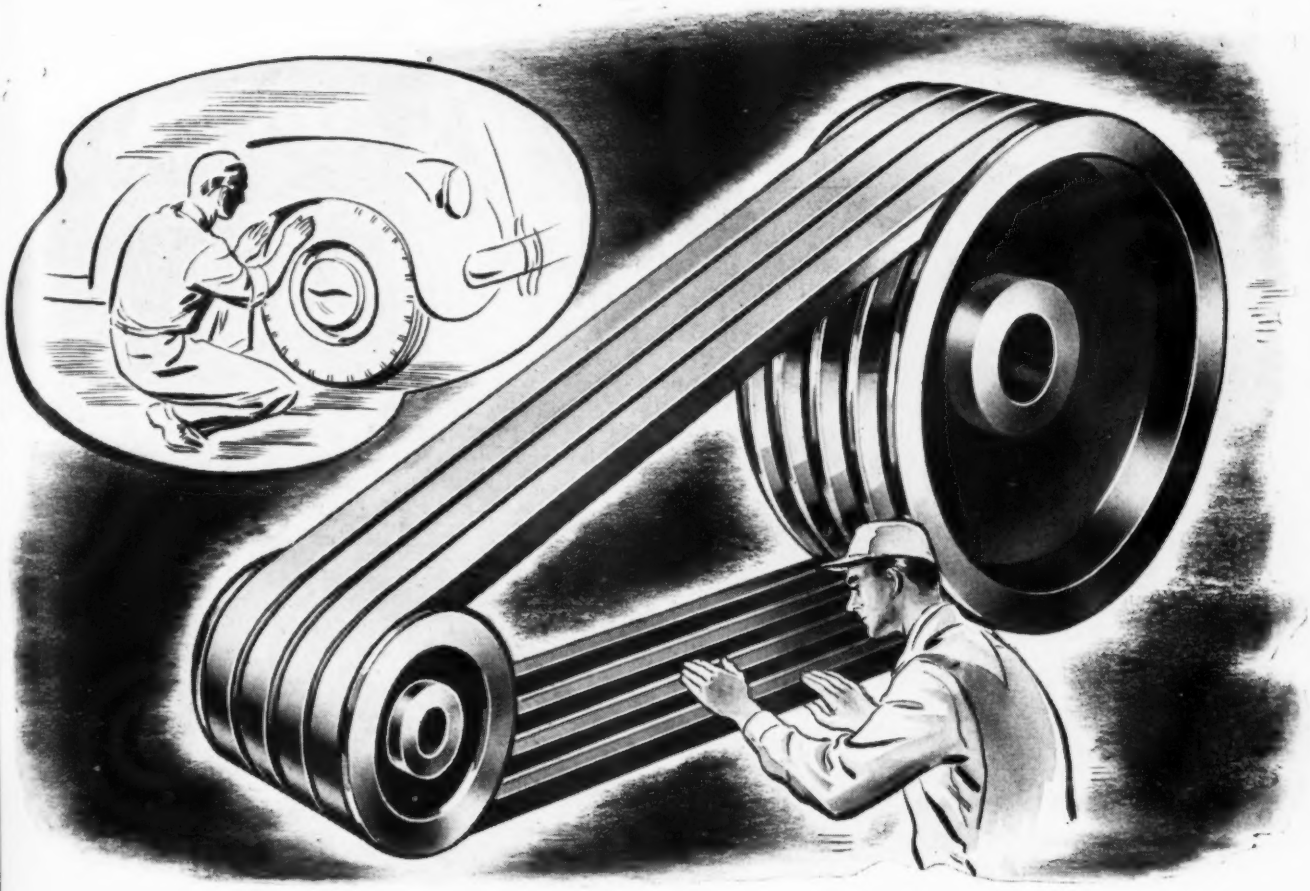
Eliminate the impurities and the oil will do a perfect job.

Systematic Oil Purification with a Honan-Crane "Continuous" Oil Purifier will remove acids, sludges and any other impurities that are a constant threat to safe Turbine Operation.

Why fight against all of these troublesome factors when it is so easy to remove them.

For complete information write for Bulletin 300T on Turbine and Hydro-Electric Generator Oils.

HONAN-CRANE
CORPORATION
1200 SIXTH ST.
LEBANON, INDIANA



Check your V-Belts as you do your tires!

GAS RATIONING and tire inspections have *really* made America rubber conscious. With no rubber in sight for civilian use for many months to come, automobile owners are now getting hundreds of extra service miles that formerly were wasted by carelessness and neglect.

It's just as important to prevent waste of V-Belt life—in fact, more important! Multiple V-Belt Drives are vital for victory—because they turn the wheels that make what it takes to whip the Axis. Premature wear not only wastes rubber, but unnecessary shut-downs delay deliveries!

There are 23 Ways to Conserve the Life of Your Multiple V-Belt Drives, and they're all explained in the Association's handbook prepared by the Engineering Research Bureau. Over fifty thousand copies have been distributed free of cost to power users. If you haven't received a copy, get one and do your part to save rubber to win the war.

MULTIPLE V-BELT DRIVE ASS'N

TRADE MARK

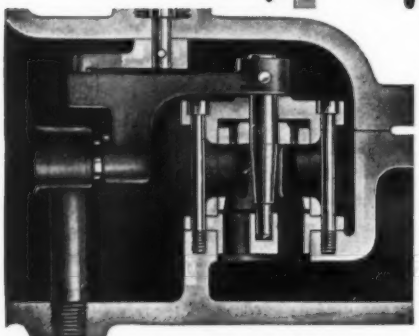
The use of this emblem by an association member in connection with Multiple V-Belt Drives is your assurance of mechanical excellence . . . the result of cooperative engineering, research and experience.

MULTIPLE V-BELT DRIVE ASSOCIATION

140 SOUTH DEARBORN ST., CHICAGO

Write for this FREE Association Book Today!

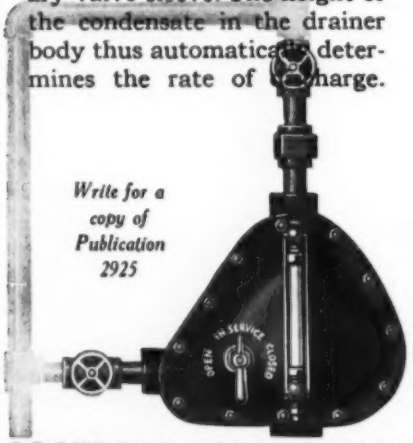
The Secret of this Drainer's Great Capacity



The Cochrane Balanced Rotary Multiport Valve

COCHRANE DRAINERS are famous among power plant operators for their tremendous discharge capacity. Wherever large quantities of condensate must be continuously removed as from evaporators, heaters, separators, coils or steam lines, under vacuum or positive pressures, Cochrane Drainers are specified by experienced plant men. The secret lies in their multiport valve construction, a series of longitudinal parts in the rotary valve matching similar parts in the stationary valve sleeve. The height of the condensate in the drainer body thus automatically determines the rate of discharge.

Write for a copy of Publication 2925



COCHRANE CORPORATION
3106 N. 17th St., Philadelphia, Pa.

COCHRANE
STEAM SPECIALTIES

J L Poyas has been appointed by **Quaker Rubber Corp** as Houston branch manager. Mr Poyas joined the company immediately after World War I, and has been with the company in various capacities since. **H M Sossaman,** former Houston branch manager of the company, returns to the Philadelphia office, becoming one of the assistants to the general sales manager.

o

F B Allen, of Allen-Sherman-Hoff Co, Philadelphia, is president of the Metropolitan Philadelphia Society for Crippled Children, which is sponsoring an **Easter Seal campaign.** Proceeds from the sale will send crippled children to health camp, and help operate placement bureau for the handicapped.

o

New applications of the heat-transfer **"electrical brain"** at Columbia University, New York, N. Y., were revealed March 5 to a group of McGraw-Hill editors visiting the laboratory of **Dr Victor Paschkis.** Editorial representatives from several publications inspected Dr Paschkis laboratory, which is now filled to the ceiling with the electrical elements that hook together to solve heat-flow problems. Editor Swain described the original form of this apparatus in POWER, July, 1941, page 76.

According to Dr Paschkis, the **laboratory is now and has been busy** on a variety of problems, including: temperature distribution in furnace walls; summer cooling load and heat absorption of building walls; heat-loss in steam-pipe insulation; permissible load in intermittly operated buried cables; heating up of furnace walls from cold; influence of thermal short circuits on the heat losses of heated structures.

o

In line with the company's policy, the **McClave Co** has named a representative to serve in the southeast, Carolinas, and Virginia. He will be **Thomas Cooper,** at 428 N Laurel Ave, Charlotte, N. C. Mr Cooper's official title is sales manager. . . . The Dominion Water and Power Bureau, Surveys and Engineering Branch of the Department of Mines and Resources of Canada has published volume 83 of the **Water Resources Papers** which record the surface water supply of Canada. Send $.50 in money order, payable to Receiver General of Canada, to Controller of Dominion Water and Power Bureau, Department of Mines and Resources, Ottawa, Canada, for a copy of this report. . . . Promotions and personnel changes affecting five men in the general engineer-

BOILER FEED-WATER TREATMENT

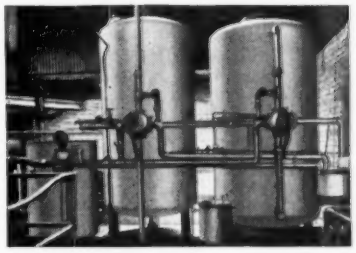
ENGINEERED BY ILLCO

lowers operation costs!

Economical to install, easy to operate, *external* treatment plants have been engineered by ILLCO for a wide variety of boiler feed-water problems. Equipment removes the detrimental constituents of the raw water at a cost which is less than that of older, inferior methods. Any desired alkalinity can be established and maintained.

CONSTANT WATER QUALITY

ILLCO External Treating Equipment produces water of a constant quality without continual supervision.



MACHINE TOOL PLANT ILLCO Duplex Feed-water Treatment Unit, blending sodium zeolite water with hydrogen zeolite water to produce a boiler make-up with zero hardness and with very low total solids and alkalinity.

MILK PROCESS PLANT Single-tank ILLCO Combination-Regeneration Boiler Feed Unit, regenerated simultaneously with salt and acid; produces same results as Duplex Equipment above. Cypress tanks avoid use of critical materials.

ZEOLITE SOFTENERS, FILTERS, AERATORS, etc. are also manufactured by ILLCO—Water Treatment Engineers. Send for complete descriptive literature.

ILLINOIS WATER TREATMENT CO.
853 Cedar St., Rockford, Illinois

TESTED IN THE LABORATORY
ILLCO-WAY
PROVED IN THE FIELD

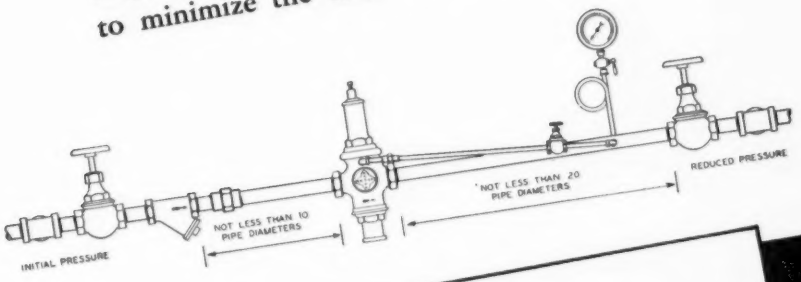
SERVICE TIPS—*for Mason No. 11 Regulators*

MASONEILAN

Number 1

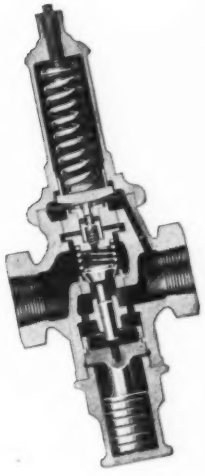
Check the Installation

For best results the regulator should be installed as shown below—using the external downstream connection and keeping all fittings a sufficient distance from the regulator to minimize the effect of flow disturbances.

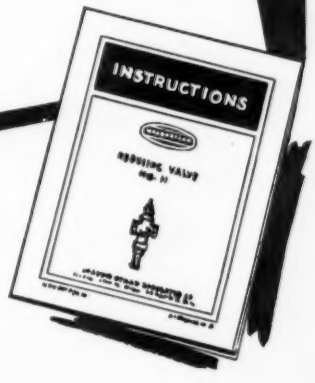


Number 2

Check the Performance



The regulator should maintain the desired reduced pressure without cycling and should shut off tightly, permitting no build-up of the controlled pressure. If it does not operate properly it is probable that some foreign matter has collected on the seating surfaces. The regulator should, in that case, be disassembled as explained in the booklet offered below.

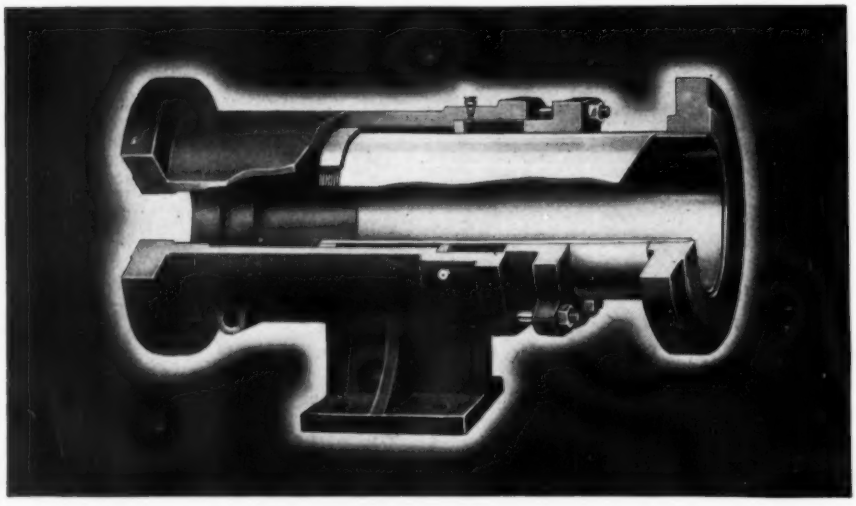


Send for this Booklet

Complete instructions for the maintenance of your Mason No. 11 Regulators are yours for the asking. Get this booklet — keep your regulators in top condition.

MASON-NEILAN REGULATOR CO.
BOSTON, MASSACHUSETTS

SOLVES SHORE OR SHIP PIPE EXPANSION PROBLEMS



COMPACT-SAFE

- **SAVES VALUABLE SPACE**
- **HUNDREDS IN USE**

Excessive strain and stress on pipe lines can be controlled and lines kept tight by the use of the ADSCO Internally Guided Expansion Joint. Compact—adaptable to close quarters—saves valuable space. Hundreds of these joints now controlling the expansion and contraction of steam, hot water or oil lines in defense plants, aboard ships, etc.

Safe — designed with an internal guide ring that acts as a positive limit stop and prevents slip from pulling out of body. Available in a complete range of sizes and traverses for low or high pressure pipe lines with semi-steel, steel, all bronze or galvanized bodies.

Write for quotation or Bulletin No. 35-30PR.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for Over 60 Years

ADSCO INTERNALLY GUIDED EXPANSION JOINT

ing department of **Monsanto Chemical Co** were made and announced. W A **Cleneay** was transferred to St Louis to head defense activities; **E R Campbell** will head salvage and surplus section also in St. Louis. Both men have been working at Texas City plant. **Milton Welhoelter,** mech engr at Nitro plant, has been transferred to process engineering division and is assigned to Texas City plant. **O F Simons,** a newcomer to Monsanto, initially will be at Central Research Labs in Dayton and **Lester Herring,** was transferred from salvage dept at St Louis to operating organization at Texas City.

✪

Charles R Fay, Westinghouse, has been granted a leave of absence to help develop plans and procedures which will be required to administer the new **Controlled Materials Plan** of the War Production Board. . . . **Rogers Diesel and Aircraft Corp** has set up marine div to handle all the company's business in that line. Edward H Davis will be manager of the new division. . . . Promotions of **Dr Nicholas N T Samaras** and **Roy W Sudhoff** to assistant directors of the central research dept of Monsanto Chemical Co were announced recently.

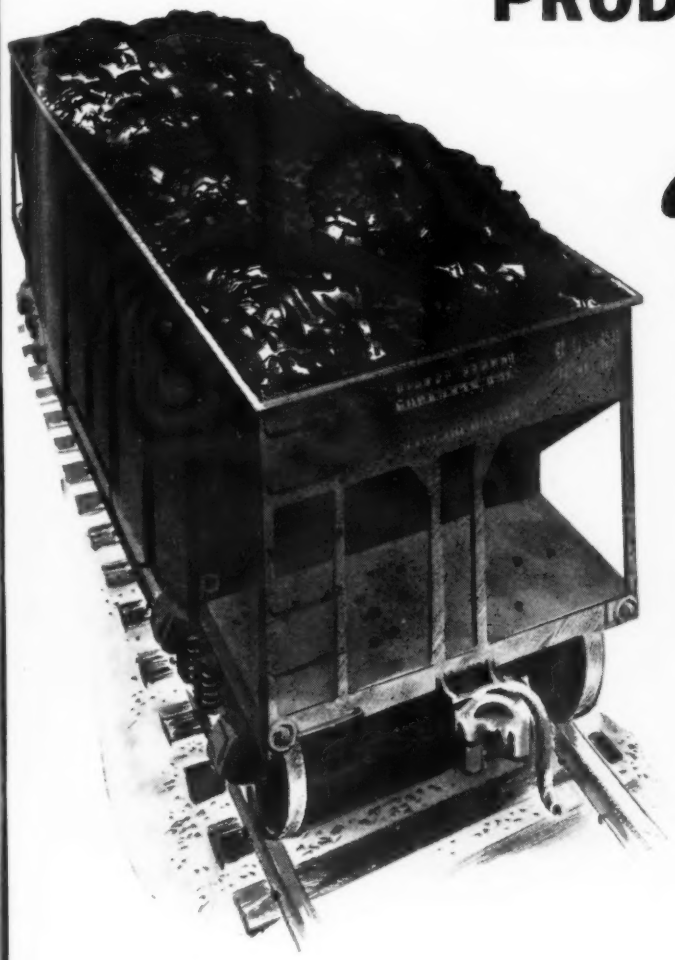
✪

R W Beard, who formerly handled planning and execution of the General Electric Federal and marine program in the San Francisco territory, has been named assistant to the manager of the lighting division at Schenectady. . . . E G Hartmann has been promoted to assistant general manager of sales of **John R Roebling's Sons Co. Douglas W Vernon,** previously chief of the company's priorities division, has been appointed assistant to the general manager of sales. . . . **David Hall,** 68, Westinghouse engineer since 1908 and active in the electrical industry for the past 46 years, retired Jan 1, 1943. . . . **Cooperation among manufacturers** was the keynote of a 2-day meeting for representatives of leading industries, held Jan 14 and 15 on postwar planning. Sponsored by the **Carrier Corp,** the conference was attended by representatives of many industrial firms. Subjects discussed included **postwar employment, production, marketing** and **distribution.**

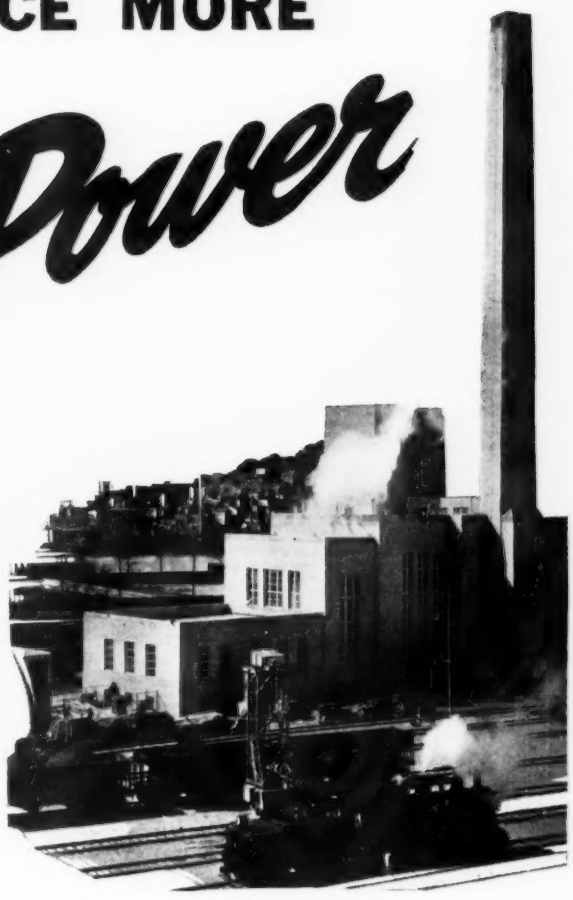
✪

An unofficial title-by-title comparison of the original and revised Occupational Bulletin No 9, listing utility jobs which are eligible for draft deferment,

MAKE EVERY CAR OF COAL PRODUCE MORE



Power



AMERICA'S transportation systems are under extreme pressure. War equipment—materials—men—must be moved with all possible speed. Shipping space is vital. Any that can be saved contributes to our war effort.

Many power plants are effectively conserving fuel, by the use of

Carey HEAT INSULATIONS

thereby helping to ease the transportation load.

• *One 15-ton car of CAREY 85% Magnesia, applied to exposed hot surfaces, can save 80 CARS of coal, of 40 tons each, per year.* Of course, you don't operate with heated surfaces fully exposed. But if your insulation is inadequate, your equipment to that degree, is losing heat and wasting fuel that might be saved.

• Since CAREY Heat Insulations normally return their full cost in savings in only a few months, any reduction in heat loss through improved insulation is bound to be highly profitable. A complete check of your insulated equipment will reveal to what extent, if any, your insulations fall short of top efficiency. The nationwide CAREY distribution and engineering organization is at your service. For Catalog, address Dept. 16.

THE PHILIP CAREY MFG. COMPANY • Lockland, Cincinnati, Ohio

Dependable Products Since 1873

IN CANADA THE PHILIP CAREY COMPANY, LTD. Office and Factory: LENNOXVILLE, P. Q.

THERE IS WHY IT IS GOOD BUSINESS TO SEE THAT YOU GET

BATES-GRATES

FOR OPEN STEEL FLOORING

That scraper edge on the Bates open steel flooring cross bar is cleaner and safer. You grasp the idea from even a quick glance at the picture. Yet it doesn't cost you a cent more.

You get those extra advantages because the Bates patented process builds a fillet from displaced metal—in addition to the clean scraper tread of the "Hex" cross bar, giving you smoother, cleaner, larger welds *and stronger flooring.*

The whole process is explained—and many fine installations pictured—in the 8½ x 11 catalog, "FILLET-WELD BATES GRATES." Write for a copy.

WALTER BATES COMPANY, INC.
1707 ROWELL AVENUE • JOLIET, ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS

has been completed by the Council of Electric Operating Companies after consultation with the War Manpower Commission officials. Copies may be secured upon request to the Council of Electric Operating Companies, Washington office, at 324 Homer Building.

✪

Savings of more than 99% in the tin content of bearing babbitt and the possibility of completely eliminating costly anchoring methods were two of the outstanding advantages recently disclosed in tests being made at the **Cooper-Bessemer Corp,** Mt Vernon, Ohio. To quote: "With a large proportion of the world's tin supply under enemy control," said **Ralph Boyer,** chief engineer, "we believe we have found a most satisfactory alternate for commonly used bearing alloys of high tin content. This will undoubtedly be suitable for all bearings with the possible exception of those subjected to the most severe stresses." According to research and development engineers of the company, a comparatively new metal-cleaning method known as the **"Kolene"** process **(see POWER, Oct. 1942, p 101)** was credited largely for their success in being able to use and satisfactorily anchor lead-base bearing babbitt. The installation for handling the "Kolene" process at the Cooper-Bessemer Mt Vernon Works is one of the largest of its kind in the country.

✪

An eight-page leaflet designated OCD Publication 5214, is a **Plant Protection Fact Sheet,** containing the highlights of a booklet entitled, "Passive Protection for Industrial Plants," recently issued by the Office of Civilian Defense. The pamphlet contains suggestions for the protection of personnel, property and material from the effects of air raids, as well as fire accident, espionage and sabotage. Also describes methods for organizing and training air wardens, police, special police, fire wardens, etc. If you want a copy, write to **Randolph Feltus,** chief of the editorial section, Office of Civilian Defense, Washington, D. C. Refer to **OCD Publication 5214.**

✪

John M. Davies, in the research division of the **B F Goodrich Co** since 1926, has been named director of physical research. . . . The new address of the **United States Gauge Co** is 14 Wall St, New York, N. Y. Factory is located at Sellersville, Pa., and **all gages or instruments requiring repair** should be shipped directly to that factory.

..for Valves

Fortunately, in these days of shortages, old valves can be pepped up and put back to work. New parts are the vitamins, and engineers are prescribing them successfully. The securing of priority for complete, new valves is at best a major operation, whereas it is usually both easier and thriftier to obtain replacement parts and make repairs.

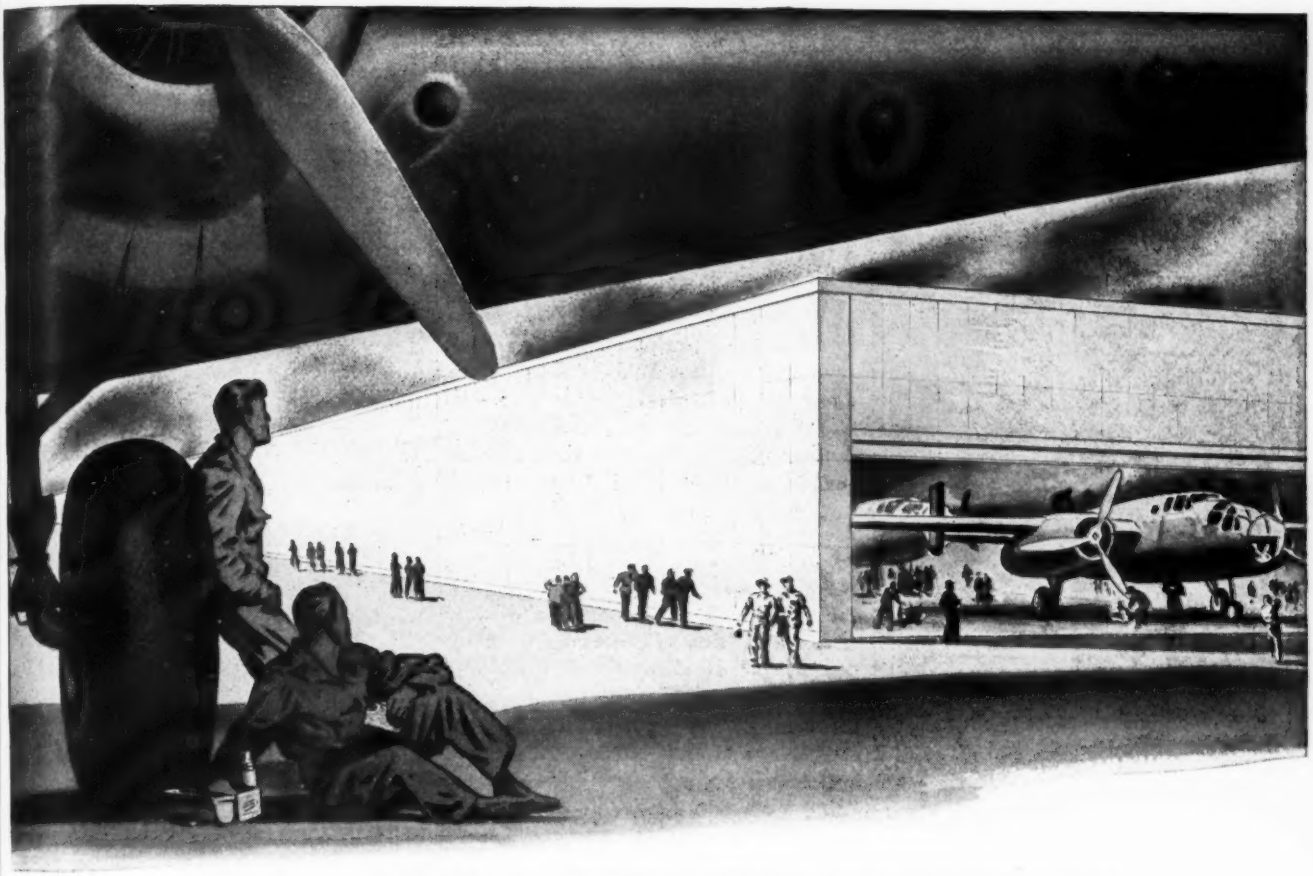
Ludlow Valves that have been retired after years of hard service can often be put back to work with a new part or two — demonstrating what astute engineers have long realized—*Ludlow means Value.*

THE LUDLOW VALVE MFG. CO., INC.
TROY, NEW YORK

Construction Features: Self-releasing 30° angle wedges and free-floating gates, self-adjusting to seats, afford smooth, trouble-free performance, long service. Rings are cleaned throughout stroke action. Gates are wedge-locked directly opposite ports and completely unwedged before raising. Ample tolerances provide easy action. Simple construction permits easy replacement of parts.

LUDLOW VALVES
SINCE 1866

Looking ahead with Asbestos



"BOY, NOTHING HERE BUT A VACANT LOT 98 DAYS AGO!"

"Yes, sir," says Joe Wingworker, "Three months ago she was just a vacant lot, full of weeds and old tin cans. And now look at her! That asbestos lumber made a plane plant spring up mighty quick. And they tell me the stuff won't rot or rust or ever need paint."

Righto, Joe! That "Stuff" is Keasbey & Mattison's "Century" Apac Board, and if you have anything to do with construction or maintenance after this war, you'd better make a note of it. Why, it's not only maintenance-free, it actually gets tougher with age and it's fire-resistant and weather-resistant.

Also remember, Joe, that Apac is an all purpose board . . . it is designed for roofing or siding and for interior walls, ceilings and partitions. No wonder more than 50,000,000 square feet have been used in essential war construction to date. "Century" Apac Board goes up fast . . . is trouble-free thereafter.

Total war has shown manufacturers in all fields how to produce faster and better. This, coupled with the fact that wartime building needs have lessened considerably, means that this material is now available again for widespread use.

If industry has its way, this new production efficiency will be kept at work after the war, making all the things a peacetime world will want and need—new things resulting from vision and research today.

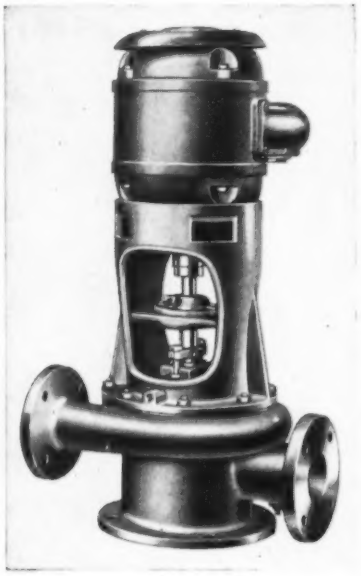
* * *

Nature made asbestos;
Keasbey & Mattison, America's asbestos pioneer, has made it serve mankind . . . since 1873

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

Makers of

asbestos-cement shingles and wallboards; asbestos and magnesia insulations for pipes, boilers, furnaces; asbestos textiles; asbestos electrical materials; asbestos paper and millboard; asbestos marine insulations; asbestos acoustical material; asbestos packings; asbestos corrugated sheathing and flat lumbers; asbestos-cement pipe for water mains



The PUMP with THE USABLE FEATURES

The new Economy SCV pump provides all these important features.

- Vertically designed—saves floor space.
- Motor mounted high above pump mounting flange away from dirt, splash and sweepings.
- Complete rotor assembly removable without disturbing piping connections.
- No prolonged shut downs due to motor failures—any comparable stock motor easily adapted.
- Impeller keyed to oversize shaft, rotating between two bearings—smooth and noiseless operation.
- Built in sizes from 1" to 3" discharges for capacities from 10 to 500 G.P.M. with heads up to 225 feet.
- For cold or hot water application, boiler feeding, pressure boosting, refrigeration service, washing equipment, air conditioning systems, etc., etc.

Write for catalog D2-1042 fully describing and illustrating this new Economy Pump.

Economy Pumps, Inc.
1020 Weller Ave.
HAMILTON OHIO

War Bonds to the extent of $650 have been awarded in a nationwide contest designed to reveal to industry the most outstanding methods of **salvaging and maintaining machinery** under wartime conditions. Sponsored by **Metallizing Engineering Co, Inc,** L I City, N. Y., this is the second of a series of contests open to users of any metal-spraying equipment in the United States and Canada. First prize went to **John Frisch,** mechanical engineer, Price Bros & Co, Ltd, Riverbend, P. Q.; second prize was awarded to **George E Morgan,** machine foreman, Pressed Steel Car Co, Inc, McKees Rocks, Pa.; and third prize was given to **Bertram L Bailie,** plant engineer, Hiram Walker & Sons, Inc, Peoria, Ill. Entries were judged by A M Perrin, president of National Conveyors Co, New York.

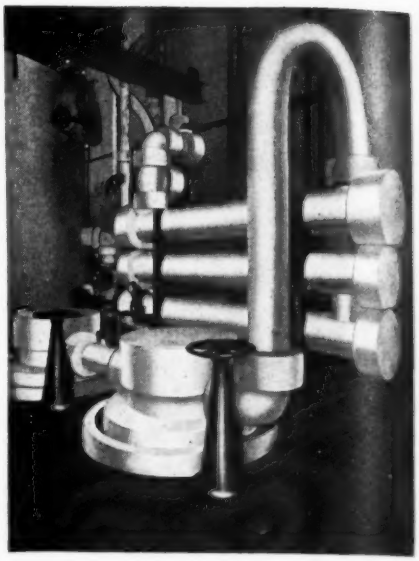
o

Appointment of **Dr P W Leppla** to the position of chief chemist of the research division is announced by **Cardox Corp.** Dr Leppla will make his headquarters in the general offices of the company in Chicago, reporting to Dr Charles A Getz, director of the research division. . . . Announcement has just been made by the B F Goodrich Co, Akron, Ohio, that its line of **vibro-insulators** (rubber mountings) can now be made using its **Ameripol synthetic rubber.** These mountings, which are used for the isolation and insulation of vibration, shock and noise, have been offered for many years using natural rubber bonded to metal. . . . **John C Kjerner,** president and general manager of the **Fedders Mfg Co,** has been commissioned as a first lieutenant in the U S Marine Corps.

The New York office of the **Mixing Equipment Co, Inc,** is now at 136 Liberty St. **Glenn J Moorhead,** formerly Pittsburgh representative for the company, has assumed the position of Eastern Divisional sales manager, with headquarters at the new location. **C F Donovan** will continue his duties as manager at the Liberty Street address. . . . **Quaker Rubber Corp** announces that **J L Poyas** has been named Houston branch manager. . . . **Oscar E Kiessling,** of Washington, D. C., is the newly elected secretary of the **Machinery and Allied Products Institute,** succeeding George Terborgh, who has been advanced to the position of research director.

o

There is no immediate danger of a shortage of high-grade iron ore in the United States, even if a wartime consumption rate of 100 million gross tons



HENSZEY

CONTINUOUS BLOWDOWN

is helping produce MORE HORSE-POWER with LESS MAN-POWER

How to get the most out of existing equipment and yet do it with fewer men than ever before is one of the many problems confronting our war production industries.

Henszey Continuous Blowdown Systems are on the job in hundreds of war production plants—helping to increase boiler and operating efficiency — helping to reduce maintenance and repairs on boilers and other allied equipment.

With a Henszey system boiler water concentration is kept below a predetermined proper safe point, continuously, automatically and without heat loss. This method of control insures clean boilers, clean water and clean steam which means:

1. CONTINUED OPERATION—boilers can efficiently produce maximum output for longer periods of time between shutdowns. Scale, priming, foaming and carryover are controlled.
2. LESS MAINTENANCE — no unnecessary manhours lost keeping boilers clean, replacing tube burns, replacing packings, repairing or replacing rods and cylinder rings, turbine nozzles, turbine blades, reducing valves, non-return valves and other troubles.
3. LOWER POWER COSTS—lower cost per h.p. means fuel savings—vitally important with present and threatened fuel shortages.

Send for bulletin

HENSZEY COMPANY
Dept. D4 Watertown, Wis.

HENSZEY

POWER PLANT SPECIALTIES

YOUR *Scrap* CAN POSTPONE 1950

FROM these reserves, two extra pounds of ore must be used for each pound of scrap you fail to turn in.

Vast as they are, America's precious iron deposits are not limitless. Considering the terrific drain on them now for those extra pounds to win the war, experts say our high-grade Lake Superior district reserves will be exhausted in a few more years . . . by 1950 . . . or sooner.

So the steel industry needs every pound of scrap you can muster . . . today, next week, next month, every month. Scrap is vital for Victory over the Axis . . . and vital also, to conserve the natural resources we shall need for reconstruction after Victory.

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO

THROW YOUR SCRAP INTO THE FIGHT
TRADE MARK
YOUNGSTOWN

FOR VICTORY
BUY UNITED STATES WAR BONDS AND STAMPS

HERE'S THE

FLOW RATE CHART

THAT'S REALLY

EASY TO READ

GET THE WHOLE STORY AT A GLANCE!

Why worry with factors and "micro-scopic" low rate readings when all Simplex MS meters use an evenly spaced chart—with even graduations from 0 to maximum.

WHAT DOES THIS MEAN TO YOU?

1—**The direct reading chart with 0 factor only, assures the same high accuracy and ease of reading anywhere in the flow range from minimum to maximum flow.**

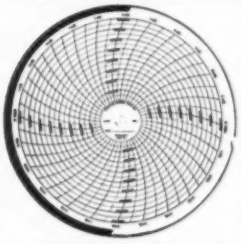
2—**Even graduations make it easy to read low as well as high flows from a distance.**

3—**Greater accuracy of chart readings from planimeter.**

4—**Extreme accuracy of chart record is inevitable since pen arm connects directly with bell-shaped float.**

5—**Special moisture proof paper eliminates stretching and shrinkage — chart cannot slip in use.**

Simplex has "engineered" the chart on the MS meter as well as every mechanical detail. This direct reading chart is made possible because of the unique bell-shaped float which extracts the square root of the law of flow. Here is accuracy, ease of recording, and ease of reading — yours for the using in every Simplex Type MS meter. There is no finer meter at the price. Specify Simplex MS meters. Write for details today.



12" circular chart for daily or weekly removal. Electric or mechanical clock drive.

SIMPLEX VALVE & METER CO.

6780 UPLAND STREET, PHILADELPHIA, PA.

SIMPLEX

POWER & PROCESS METERS

THE METER WITH THE BELL SHAPED FLOAT

a year continues. With proper advance planning and appropriate action, **ore sufficient to meet all needs** likely to arise in any predictable future, **can be produced.** These, in brief, are the major conclusions reached by the Division of Industrial Economics of the National Industrial Conference Board, which has just completed a detailed study of the situation. Write to the **National Industrial Conference Board,** 247 Park Ave, New York, N. Y., for further information. . . . **T C Wescott,** engineering manager, and **Harold H Scaff,** comptroller, have been elected vice-presidents of **Ebasco Services, Inc.**

✪

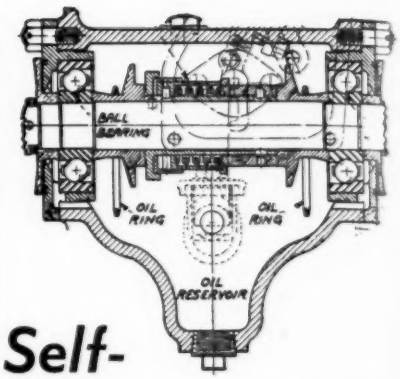
The largest single order for conveyor belt ever written in the history of the rubber industry—totaling more than 66 miles—has been awarded to the **B F Goodrich Co,** announces W S Richardson, general manager of the company's industrial products division. The belt will require **50 standard railroad cars** to move it when it is completed. It will go into production in one of the company's plants now engaged in rubber and synthetic rubber products for the armed forces.

✪

Officially, it's the **Office of War Utilities,** with **J A Krug** as war utilities director. That is the title for the new independent agency established within WPB with exclusive jurisdiction over electric power, gas, water and communications (except radio). The administrative order setting up the office and outlining its duties and responsibilities was signed February 13 by WPB Chairman Nelson. Formal delegation to the agency of **WPB's authority over utilities** followed by three weeks Nelson's announcement of Krug's appointment. Coincident with the effectiveness of the administrative order, Krug announced the appointment of **Barclay Sickler,** formerly deputy chief of WPB's power division as director of the power division in OWU. Krug also announced that **Edward Falck,** formerly chief of the power division's supply allocations section is to be deputy director of OWU.

✪

As a contribution to the war effort, the **American Colloid Division** of E F Drew & Co, Inc, has been assisting **U S Maritime Service** in training civilians for Merchant Marine positions by donating time, services and equipment for an intensive 5-week course in boiler feedwater treatment. The course, presented at the U S Maritime Service Station at Sheepshead Bay, Brooklyn, N. Y., and supervised by **Lt Com J D**



Self-Lubricated

The COFFIN-Steam Turbine CENTRIFUGAL PUMP

Self-contained ring type lubrication, supplied from a centrally located oil reservoir within the housing, makes the Coffin pump independent of external lubricators.

The oil level is maintained and the reservoir refilled by means of the single oil cup provided.

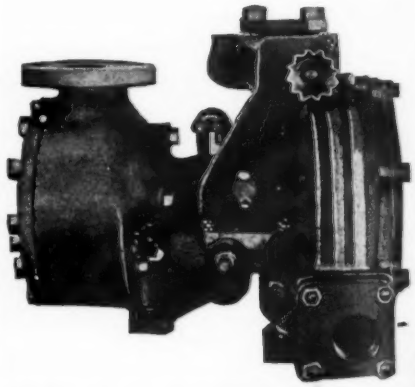
The temperature of the oil in the reservoir is water cooled by means of a continuous coil when cooling is required.

PRESSURES

To 750 Lbs. Sq. In.

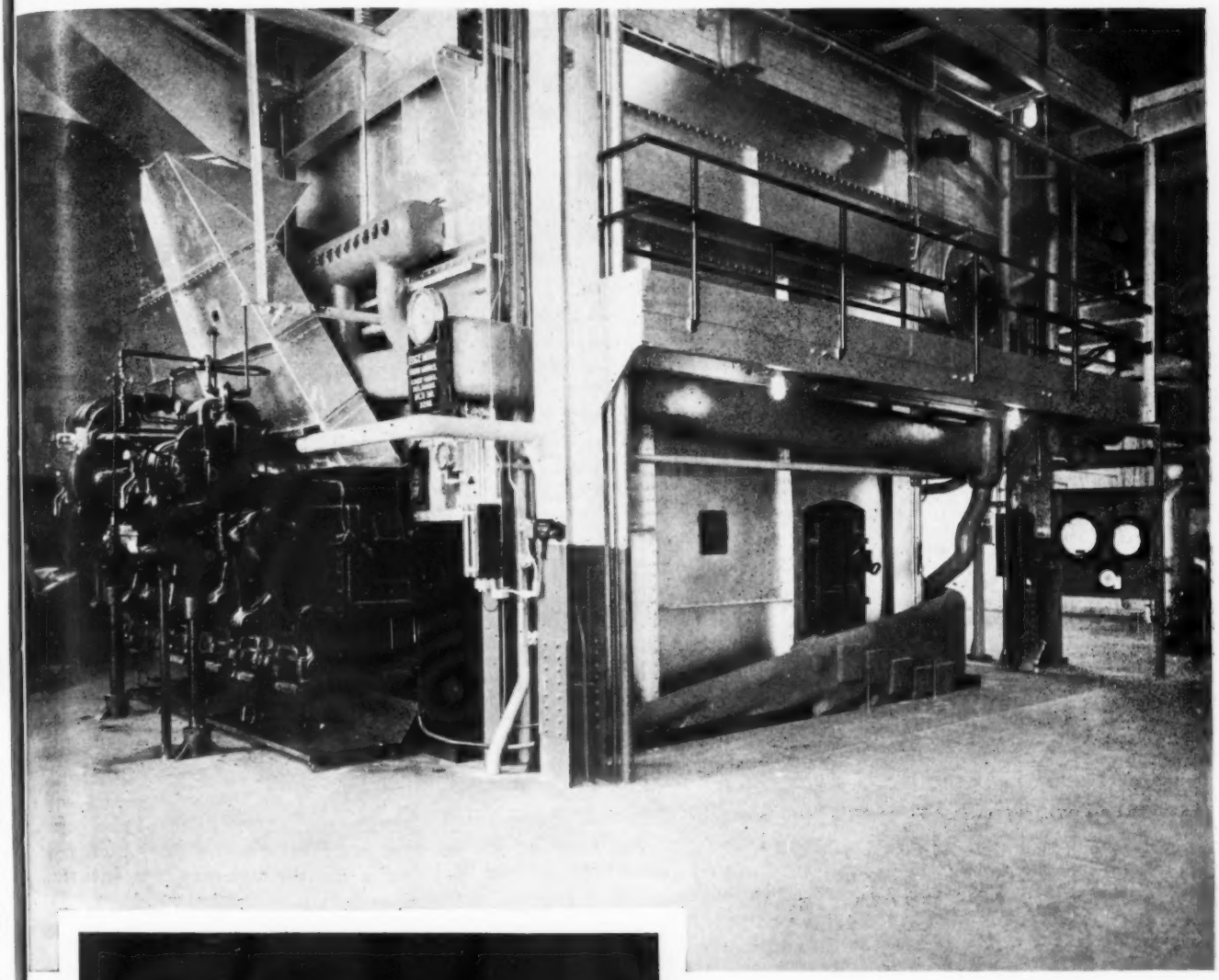
DELIVERIES

To 500 G.P.M.



THE J. S. COFFIN, JR., CO.

ENGLEWOOD, N. J.



A LOT OF STEAM

at high pressure and low cost... from this neat, compact, highly efficient

EdgeMoor

• Partial front and side view at firing floor elevation of one of two EDGE MOOR 3-Drum Boilers each of 112,500# of steam capacity at 600# pressure at 825° steam temperature.

These boilers were built and erected by EDGE MOOR complete with EDGE MOOR Superheaters, Water Walls, and Economizers, for the Board of Public Works, Holland, Michigan.

Consulting Engineers:
HAMILTON & WEEBER
Grand Rapids Michigan
and
GIFFELS & BALLET
Detroit Michigan

EDGE MOOR IRON WORKS, INC. 30 ROCKEFELLER PLAZA NEW YORK, N. Y.
KANSAS CITY CHICAGO DETROIT RICHMOND, VA.
IN CANADA:— UNITED STEEL CORPORATION, LTD., TORONTO, MONTREAL

HOW TO SAVE FUEL

AT A GLANCE

CUT HEAT LOSS WITH

RANAREX

as much as 20%

MEASURE CO_2 in flue gases by simply looking at the easy-to-read Ranarex* scale. Then you can easily adjust combustion until the percentage of CO_2 is at the point that gives you the *utmost power* from the fuel you burn. You eliminate guesswork, stop wasting fuel. Users report big savings.

Ranarex requires no skill whatever to operate. It's so simple it can be taken apart with a screwdriver. It contains no chemicals or fragile parts to get out of order. Yet it gives instant readings, accurate to within 3/10 of 1%.

Write for full details about this amazing fuel-saver. The Permutit Co., Dept. A, 330 West 42nd St., New York, N. Y. In Canada: Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto . . . Winnipeg . . . Calgary.

*Trade-mark Reg. U. S. Pat. Off.

Product of

PERMUTIT

Kelly, USMS and **Lt F J Brady** of the engine training division, was designed to furnish Merchant Marine instructors with full data regarding the treatment of boiler water on Liberty ships.

✪

The Navy needs mechanical engineers who can qualify as operating, maintenance and inspection officers afloat and ashore. Candidates must meet naval physical requirements and possess officer-like qualities. The age limit is 50 years, and a degree in mechanical engineering is required. In lieu of a degree, 10 to 15 years experience in the field of mechanical engineering must be evidenced. If you think you can qualify, make application to the **Office of Naval Officer Procurement,** 33 Pine St, New York, N. Y. Ask for **Kenneth G Castleman,** director.

✪

Handy & Harman, New York, announced the opening of a Los Angeles office. **H A Folgner,** connected for many years with the company's brazing engineering division in New York, has charge of the office, which is located in the Bendix Bldg, 1206 S Maple Ave, Los Angeles . . . **The Bristol Co,** Waterbury, Conn., announces several personnel changes. **E L Stilson** has been appointed assistant sales manager with headquarters at the general offices at Waterbury; **L G Bean** has been made vice-president in charge of engineering and sales; and **Harry E Beane** has been named sales manager of the company.

✪

The Midwest Power Conference will be held April 8 and 9, 1943, in the Palmer House, Chicago. The tentative program has been issued, and it presents a partial list of speakers at the conference. **H B Gear,** vice-president, Commonwealth Edison Co, Chicago, will be a speaker at the opening meeting, as will **M P Cleghorn,** president of mechanical engineering, Iowa State College; **C W Kellogg,** president, Edison Electric Institute, New York, and **Philip W Swain,** Editor, POWER. Other committee chairmen and speakers of note include **L H Hill,** vice-president, Allis-Chalmers Mfg Co; **Frederick G Straub,** research professor of chemical engineering, University of Illinois, **H L Solberg,** Purdue University; **H H Gorrie,** design engineer, Bailey Meter Co, Cleveland, Ohio; **D B Jones,** Engineering Service, Hall Laboratories, Pittsburgh; **Ronald B Smith,** manager of research engineering, Elliott Co, Jean-

G-T PACKINGS

stay soft

because they are

Self-lubricating

Pull apart a piece of any G-T packing, and you'll find the innermost strand as thoroughly saturated with lubricant as the outside of the packing. In contrast to ordinary packings, these inside strands are internal reservoirs of lubricant . . . they make G-T packings *self-lubricating*. And the lubricant is not ordinary oil . . . it is specially compounded in our own plant for each class of service. That's why G-T packings stay soft . . . last longer . . . protect shafts, rods and stems. The table below tells you the right G-T packing for your requirements.

WRITE FOR LITERATURE

BRAIDED

For rods and shafts; layer-over-layer construction insures uniformly even bearing surfaces.

TWISTED

For valve stems, each strand a perfect piece of lubricated packing. One spool packs several sizes of valves.

GREENE, TWEED & COMPANY

Bronx Blvd. at 238th St., New York, N. Y.

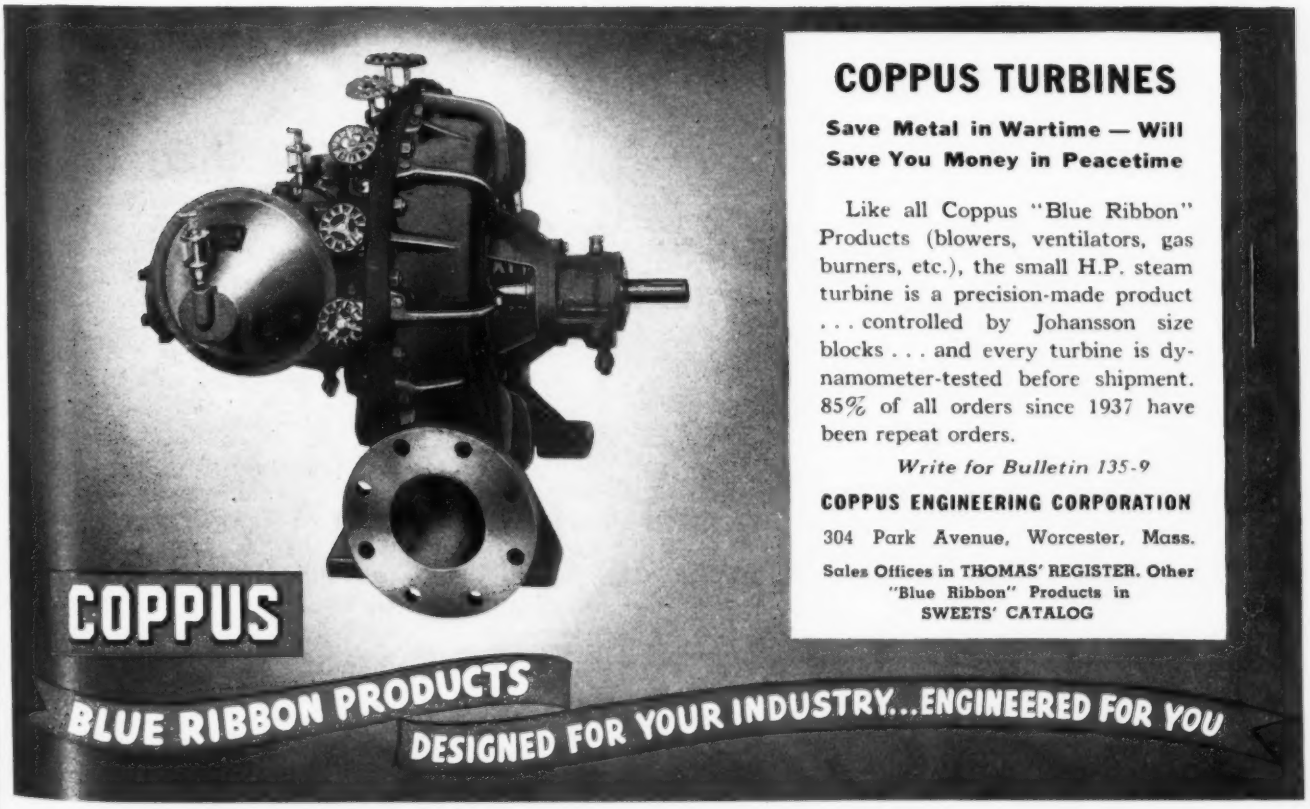
PALMETTO

for steam, hot water, air. PALCO *for water.*
PELRO *for oils.* CUTNO *for alkalis.*
SUPERCUTNO *(blue asbestos) for acids.*
KLERO *for foods.*

SELF-LUBRICATING

PACKINGS

A steam turbine needs a big frame to develop Elephant Power . But if you need only Horsepower, a COPPUS Steam Turbine saves money and metal . Six sizes from 150 Horsepower down to fractional. Each smaller size has smaller frame requires less metal and is priced less . Each is a COPPUS Blue Ribbon Turbine so you get top quality while saving money and metal .



COPPUS TURBINES

Save Metal in Wartime — Will Save You Money in Peacetime

Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the small H.P. steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

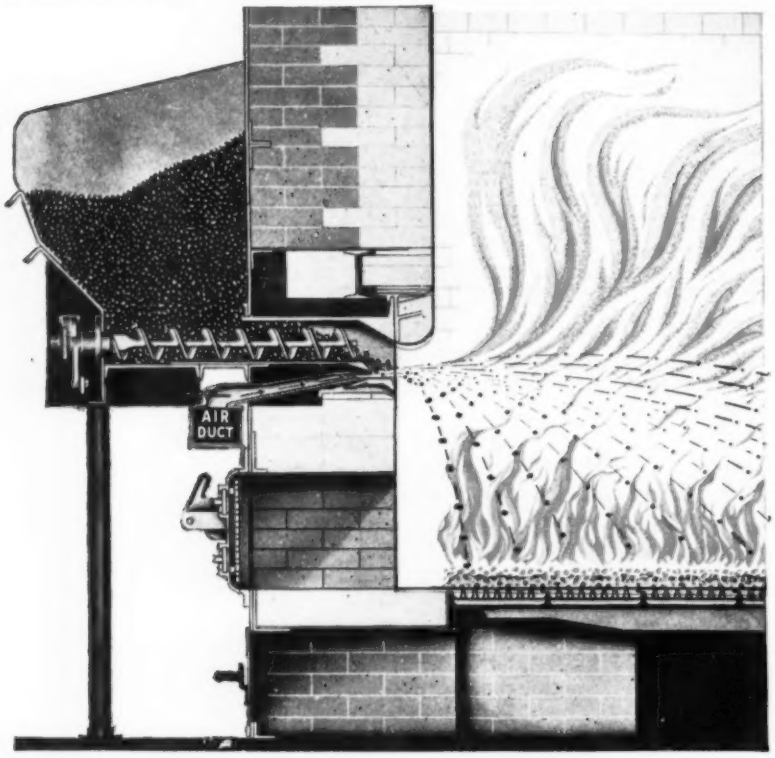
COPPUS ENGINEERING CORPORATION

304 Park Avenue, Worcester, Mass.

Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEETS' CATALOG

FYR-FEEDER

MULTIPLE SPREADER STOKERS



MEET *EVERY* WARTIME FIRING NEED!

BURN COAL LIKE OIL—FYR-FEEDERS burn fines in suspension; spread coal over entire fuel bed, burning larger pieces on grate.

USE ANY COAL—Local coals, cheap coals, screenings or sweepings—all burned efficiently with a FYR-FEEDER.

SAVE LABOR—Firing is less work with a FYR-FEEDER and anyone can operate it—experienced men not essential.

INCREASE BOILER CAPACITY—Many users report one boiler can do work of two with a FYR-FEEDER.

SAVE MONEY—Helps meet higher costs and taxes.

For Quick Conversion from Oil to Coal

These and many other advantages accrue to users of FYR-FEEDER Multiple Spreader Stokers. The FYR-FEEDER method of firing is *ideal* at *any* time, it is rapidly becoming the *only* method to solve *all* the requirements of wartime.

WRITE FOR NEW CATALOG TODAY!

AMERICAN COAL BURNER COMPANY

F O U N D E D 1 9 1 8

Builders of thousands of industrial stokers

32-18 E. Erie St. **Chicago, Illinois**

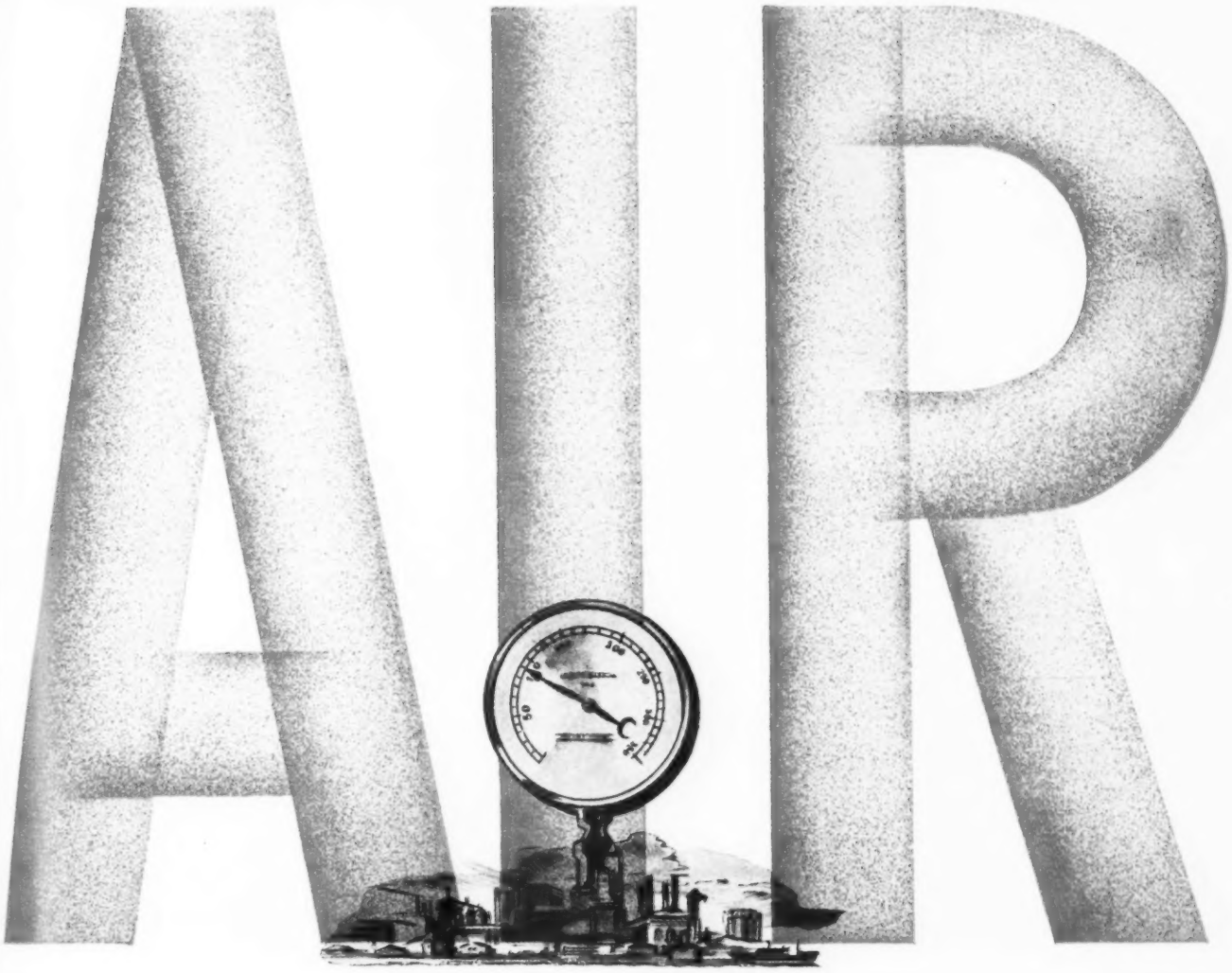
nette, Pa.; **James D Cunningham,** president, Republic Flow Meters Co; **Col James L Walsh,** chairman, War Production Committee, American Society of Mechanical Engineers; **Major Ralph W Applegate, C E,** chief, Industrial Safety Branch, Sixth Service Command and **Lt Col A G Coulson,** O D, chief, Continuous Security Branch, Sixth Service Command. Also **C W Hauck,** manager, engineering sales, Crane Co, Chicago; **A C Foster,** manager, service department, Foster-Wheeler Corp, **John I Yellott; F W Hollister,** chief electrical engineer, Sargent and Lundy, Chicago; **B V E Nordberg,** executive engineer, Nordberg Mfg Co, Milwaukee; **L E Hebl,** head, engine laboratory; and **L W Griffith, Sr,** research engineer, Shell Oil Co, Wood River, Ill.; **Otto de Lorenzi,** assistant general sales manager, Combustion Engineering Co, New York and **J R Fellow,** assistant professor of mechanical engineering, University of Illinois.

o

The National Bureau of Standards, U S Dept of Commerce, in cooperation with the **Industrial Mineral Wool Institute,** announce the successful establishment of Commercial Standard CS 105-43, Mineral Wool; "loose, granulated or felted form, in low-temperature installations." The standard covers both cold storage area and pipeline material wool insulation. Based on extensive research by engineers comprising the Institute's specifications committee, it also includes recommendations by engineers of the refrigeration field generally. Until the printed standard is available, mimeographed copies of the **Commercial Standard CS 105-43** may be obtained free of charge from the **Trades Standards Division, National Bureau of Standards, Washington, D. C.** Single copies may be secured without charge from the **Industrial Mineral Wool Institute,** 441 Lexington Ave, New York, N. Y.

o

A new method of **preventing molten metal from adhering** to parts during welding operation was recently devised. It consists of applying a light paste made by mixing an **Oakite** material with water to the area surrounding the junction to be made. Spattering molen metal will not adhere to surfaces protected by this paste, and much time and labor is saved as compared with the old procedure of grinding off the deposits. **The paste is easily removed** by brushing or dipping the parts in water.



THE 'AIR ARM' OF INDUSTRY

Applying Compressed Air for countless jobs is one of Ingersoll-Rand's major contributions for the industries of war and peace.

Armies of drill runners mining the vital metals, building the strategic roads and air fields, driving the tunnels for highways, railroads and water—all with rock drills powered by Compressed Air.

Thousands of men, women too, building planes, ships, tanks, autos, trucks, locomotives, bridges, machines, and process plants—with drills, grinders, riveting hammers, chippers, hoists—powered by Compressed Air.

Today's war production also emphasizes the use of Compressed Air for propelling torpedoes, scavenging guns, starting Diesels, for painting, for ship salvage, for blasting sirens, for inflation of tires, for blowing blast furnaces and cupolas to increase steel production. . . .

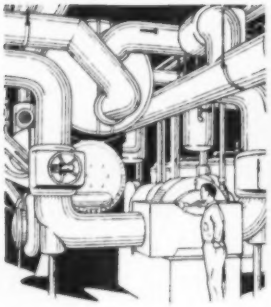
Ingersoll-Rand has pioneered Compressed Air Systems since 1871, ever developing new and time-saving applications.

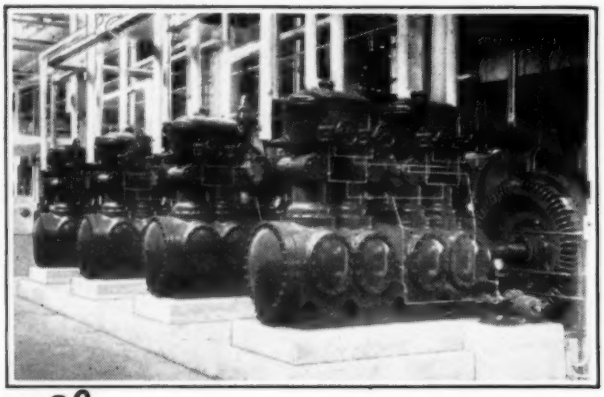
Ingersoll-Rand

11 Broadway, New York, N. Y.

1-280

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS





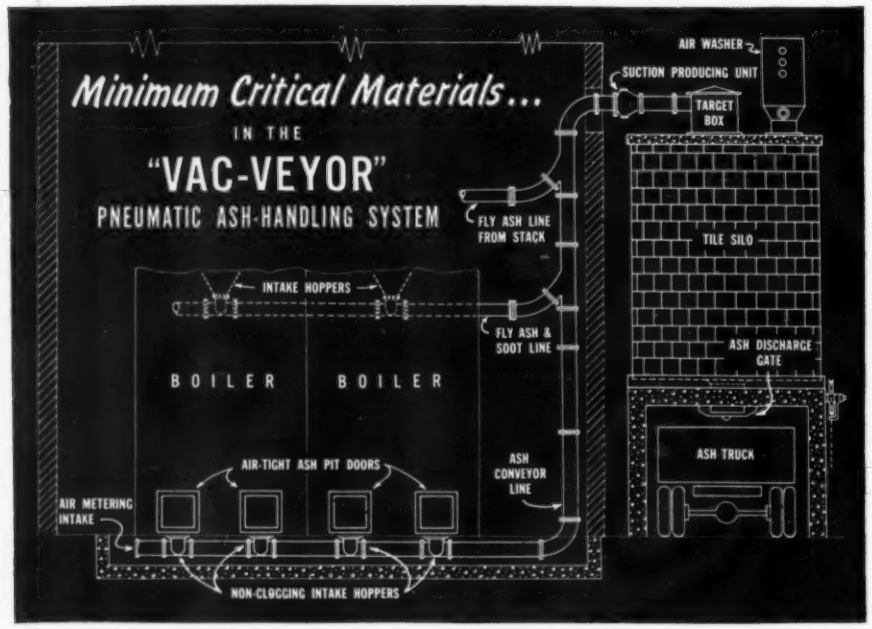
Largest Viscose Rayon Plant in U.S. Installs

At Front Royal, Va., the American Viscose Corp., which is busy with war work, has just put into operation this battery of Frick 4-cylinder ammonia compressors, together with double sets of enormous shell-and-tube brine coolers, condensers, and complete auxiliaries. Total cooling capacity is equal to the melting of one and a half million pounds of ice daily.

The really important jobs call for Frick Refrigeration. Over 60 years' experience is built into it; no wonder it's the most dependable cooling equipment made! Thousands of plants, rushed with war work, find it indispensable. Frick Co., Waynesboro, Pa.

FRICK TRADE MARK

Refrigeration



Write us today for complete details

Designed to fill today's needs in either new installations or oil-coal conversion, this pneumatic ash handling system offers numerous advantages.

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

CURRENT ARMY NAVY AWARDS

The B F Goodrich Co. Award presented March 2, 1943.

Westinghouse Electric & Mfg Co. Award presented Jan 21, 1943.

The Elliott Co. Award presented Jeannette plant Feb 5, 1943.

Cummins Engine Co. Award presented Jan. 28, 1943.

International Nickel Co. Three-star award presented Huntington Works recently.

Handy & Harman Co. White-star award presented Feb 10.

S F Bowser Co. White-star award presented recently.

Caterpillar Tractor Co. Award presented March 12, 1943.

National Supply Co. Award presented Toledo plant, Feb 10.

Edward Valve & Mfg Co. Maritime "M" Award presented March 13.

Ohio Injector Co. White-star award presented recently.

Babcock & Wilcox Tube Co. Award presented Beaver Falls plant. Feb 4, 1943.

Buffalo Pumps, Inc. White-star award presented Jan 18, 1943.

General Power, Inc. Award presented Feb 14, 1943.

✪

With the pressure of war production becoming daily more intense, and the demands upon existing pumping equipment in all types of manufacturing plants becoming greater, the Blackmer Pump Co has reprinted a **simplified check chart on the servicing of rotary pumps.** The chart is prepared in card form, punched at the top center so that it may be hung on a pipe or wall near a pump installation and serve as a constant reminder to the maintenance man. The cards will be mailed in any reasonable quantity upon request addressed to **J B Trotman,** general sales manager, **Blackmer Pump Co,** Grand Rapids, Mich. **Form No. SER-1** should be specified in the request.

✪

The Armstrong Cork Co announced February 2 that it has been advised by the War Production Board that all **restrictions on the use of corkboard** insulation had been removed. Sloane C

THE M. W. KELLOGG COMPANY

Fabricators and Erectors

of

COMPLETE PIPING SYSTEMS

for

HIGH PRESSURE — HIGH TEMPERATURE

PUBLIC UTILITY and MARINE POWER PLANTS

* * *

PROCESS PIPING FOR INDUSTRY

* * *

Heat Transfer Equipment for Industrial and Marine Power Plants

KELLOGG

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

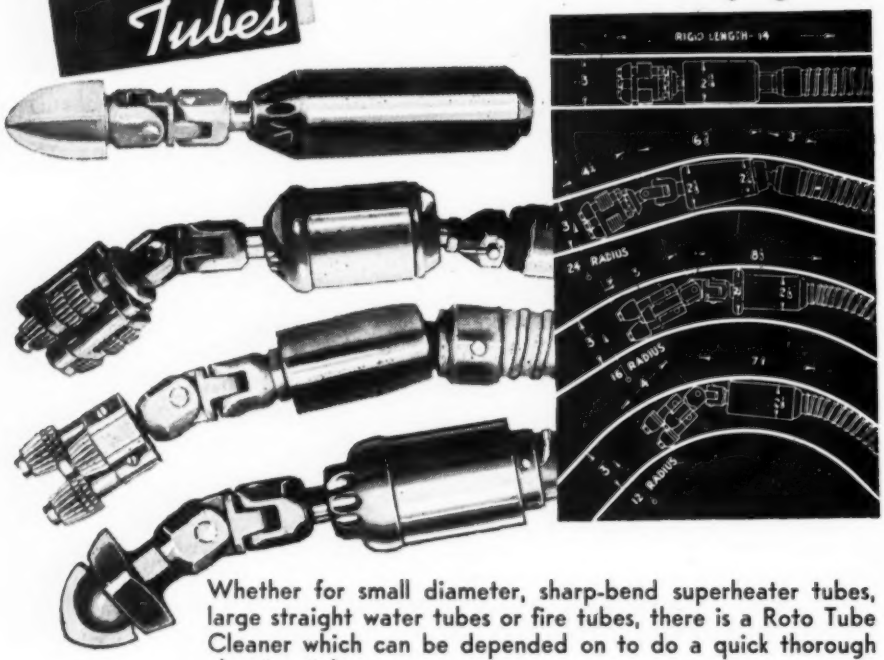
THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND TULSA: PHILTOWER BLDG.

STRAIGHT
BENT
LARGE
SMALL
Tubes

There's a ROTO for Every Tube Cleaning Job



Whether for small diameter, sharp-bend superheater tubes, large straight water tubes or fire tubes, there is a Roto Tube Cleaner which can be depended on to do a quick thorough cleaning job.

Roto equipment includes air-, steam- and water-driven types for inside tube diameters from 1/2" up. Cutter heads in a wide variety of shapes as well as scrapers and brushes are available for cleaning every kind of deposit, hard, soft or gummy.

You need ROTO service NOW to insure maximum plant efficiency. Send for complete information, stating your specific needs.

The ROTO Company
145 Sussex Ave., Newark, N. J.

They *WEAR* themselves into perfect condition

SEA-RO GRAPHITIZED
PUMP PLUNGER RINGS No. 528

Tests prove that Sea-Ro Graphitized Rings acquire a hard glass-like surface after long operation, and being of a floating type, reduce wear on cylinder liners.

Sea-Ro No. 528 Rings are recommended for plungers of pumps handling hot or cold water, oils, gasoline, solvents, ammonia, etc.

For large heavy-duty, use Sea-Ro No. 525 Rings, with patented internal expansion spring.

Send for detailed information

SEA-RO PACKING CO., INC., WOOD-RIDGE, N. J.

Martin, manager of the industrial insulation department of Armstrong's building materials division, stated that WPB Order No M-8A, as amended February 20, now permits cork to be used for roof insulation, for the insulation of air-conditioning equipment, **and for all other non-war purposes** previously banned under the mandatory priority control placed in effect by the WPB in June, 1941. **The order does not end the allocation system,** Mr Martin stated, but that monthly allocations of cork appear to be adequate for all military and civilian needs for corkboard insulation and for cork covering to be used on cold lines.

o

Wickwire Spencer Steel Co, 500 Fifth Ave, New York, announced February 19 the appointment of **Wilfred C Shattuck** as wire sales manager, operating out of the New York office. . . . The Institute of Metals Medal was awarded to **Dr Harold Moore, CBE,** a Fellow of the **Institute of Metals,** 4 Grosvenor Gardens, London, S W 1, of which he was president from 1934 to 1936, Dr Moore has had a long and distinguished metallurgical career and will receive the medal as one who has rendered "outstanding service to nonferrous metallurgy." . . . At the annual meeting of the stockholders and directors of the **Farrell-Birmingham Co, Inc,** held February 18, the following officers were elected: **Franklin Farrell, Jr,** chairman of the board and of the finance committee; **A G Kessler,** vice-president; **Carl Hitchcock,** vice-president; **Austin Kuhns,** vice-president; **R A North,** vice-president; **F M Drew, Jr,** treasurer; **George C Bryant,** secretary; and **W B Marvin,** assistant secretary.

o

The **1942 Lamme Medal** of the American Institute of Electrical Engineers has been awarded to **Dr Joseph Slepian,** associate director of research, Westinghouse Electric & Mfg Co, East Pittsburgh, Pa., "for his contributions to the development of circuit interrupting and current rectifying apparatus." The medal and certificate will be presented to him at the national technical meeting of the Institute, to be held in Cleveland, Ohio, June 21-25, 1943. . . . **Laminated Shim Co, Inc,** Glenbrook, Conn, announces the retirement of **Earl L Young,** vice-president in charge of production. Mr Young has been with the company for 22 years, since Feb 1, 1920, and had been in charge of production to the date of his retirement. . . . **Foote Bros Gear and Machine Works,** Chicago, Ill., announced the

We waited 4 Years to make this *Announcement*

★ ★ ★

EARLY IN 1938, Shell Scientists and engineers, after long tedious months of experimenting, were ready to give a new turbine oil its supreme test. Exhaustive laboratory analyses had shown it possessed properties previously thought unattainable by even the most optimistic turbine manufacturers.

But Shell men were not satisfied. "How will this new turbine oil stand up under actual operating conditions?" was the question they wanted answered.

There was but one way to find out . . . test it in turbines. They did. After a 2-year run, samples taken showed every characteristic of the original oil. Further checking was done . . . other tests were made. It still looked "as good as new."

Then, and only then, was the new Shell Turbo Oil announced. That was in January 1941. Even then many operators were doubtful that Shell Turbo Oil was as good as we claimed. "It hasn't been in use long enough," they said.

Today Shell Turbo Oil is able to show a performance record that should convince the most skeptical. For after more than 30,000 hours of operation in a power company's turbine, Shell Turbo Oil tests as well as the day it was put in over 4 years ago. To the original filling of 4,400 gallons only 300 gallons of make-up oil have been added. Certified chemical analyses of samples taken from the turbine show no signs of deterioration on any score.

30,000 hours of operation, in itself, is no record for a turbine oil. But 30,000 hours *without a single sign of structural breakdown* is a record in which every turbine operator should be interested. It is but one of scores of records being set by the new Shell Turbo Oil in all types of turbines.

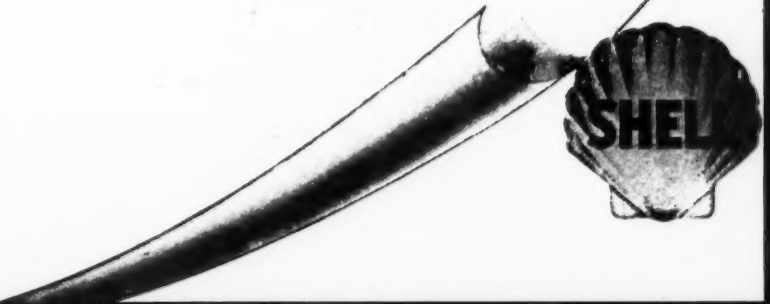
Here is proof positive that the new Shell Turbo Oil has *the two most important* characteristics necessary to the proper lubrication of modern turbines:

SUPERIOR OXIDATION STABILITY
RUST PREVENTION

Ask the Shell man for the details today!

(Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil.)

Shell Turbo Oil



CONTROL EQUIPMENT by

★K&M CONTROL ENGINEERS since 1879

REDUCING VALVES

Kieley & Mueller Reducing Valves — the products of more than 63 years specialized experience in the design and manufacture of steam specialties — include types for all services as follows: (a) ordinary reduction with comparatively constant inlet pressure and continuous flow; (b) ordinary reduction with comparatively constant inlet pressure but for dead end service; (c) pulsating inlet pressure or highly varying loads maintaining constant reduced pressure; (d) high pressure drop.

Shown here are two widely used types.

SPRING LOADED REDUCING VALVE

Suitable for steam or gas; for initial pressure to 400 lb.; made in cast steel for high pressures. Sizes: ½" to 12". Recommended for use as primary valve in double reduction installations for heating systems or for steam or gas reduction service in industrial process.

We're "ALL OUT" so the AXIS will be "ALL IN" Please bear with us for the duration —

INTERNAL PILOT REGULATING AND REDUCING VALVE

Designed for steam, oil and water; built for initial pressures of 300 lb. or less and for reduced pressure ranges of from one lb. to 75% of the initial pressure; excellent for pulsating inlet pressures and other difficult conditions. Dead end single seat shut off. Sizes: ½" to 10".

KIELEY SINCE 1879 MUELLER

KIELEY & MUELLER

General Offices and Factory:
2013-2033 — 43rd Street, North Bergen, N. J.

Reducing Valves — Liquid Level Controls — Float Valves — Pump Governors — Strainers — Control Specialties.

New DEVELOPMENTS BY FREDERICK ADD NEW THRIFT and CONVENIENCE TO INDUSTRIAL STOKER OPERATION

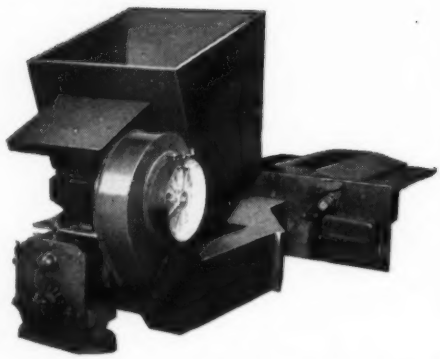
● FULL ACTIVE GRATE SURFACE . . . that's one new Frederick advantage! There's more grate area; no dead plates—whether furnished with or without side dumping grates.

● IMPROVED TUYERES are designed with air ports so arranged and proportioned as to insure thorough air distribution and maximum combustion efficiency.

● TUYERES ARE LOCKED IN PLACE so they cannot be raked up inadvertently.

● COMPLETELY ENCLOSED WINDBOX simplifies and makes a neater installation; eliminates danger of efficiency loss through leaky brickwork.

● TWO CLEAN-OUT DOORS give easy access to *both* sides of the undergrate area to facilitate cleaning.



. . . All these features, and many more, are Frederick innovations engineered to give you more for your stoker dollar than has been available ever before. A complete description of these features is in our new Stoker Bulletin. Ask for your free copy. You'll find it's interesting reading.

FREDERICK STOKERS

The FREDERICK IRON & STEEL CO.
Frederick, Maryland

COMPLETE LINE OF CENTRIFUGAL PUMPS FOR ALL PURPOSES
STEAM OPERATED ASH CONVEYING SYSTEMS - ASH STORAGE BINS

appointment of **B H Quackenbush** as assistant sales manager of that company.

✪

Fred C Smith has been appointed chief metallurgist of **Tube Turns, Inc,** Louisville, Ky. From 1936 to the date of his present affiliation with Tube Turns, Mr Smith was employed by Carnegie-Illinois Steel Co, and prior to that was plant metallurgist for the International Harvester Co. . . . **The Whiting Corp,** Whiting, Ill, announces that the headquarters of its Canadian subsidiary, **Whiting Corp. (Canada) Ltd,** has been moved to 45 Richmond St, West, Toronto, where its newly elected vice-president and general manager, **H M Rowlette,** will be in active charge of the Canadian business.

✪

H W Prentis, Jr, president of the Armstrong Cork Co, has become a member of the **Business Advisory Council** of the United States Department of Commerce, Washington, D. C. Mr Prentis joined the organization at the invitation of Jesse Jones, Secretary of Commerce.

✪

The American Society for Testing Materials has just completed publishing the 1942 Book of ASTM Standards, giving in the latest approved form, as of December, 1942, the more than one thousand ASTM specifications, tests, definitions, etc, covering engineering materials and products. The book has again been issued in three parts. **Part I covers metal,** Part II covers **non-metallic materials — constructional;** and Part III, **non-metallic materials—general.** Copies may be obtained from the American Society for Testing Materials, 260 S Broad St, Philadelphia, Pa.; the cost of each part is $9; the charge for supplements is $3 for each part, each year. . . . **Jack Hennessy** of the Geo D Roper Corp received the Chicago *Tribune* **War Workers' Award** for January for outstanding contributions to the war production program. Hennessy was selected for the award on the basis of the development of two new machines, as well as for other work "which went far beyond what might reasonably be expected of him in the line of duty." Presentation of a gold pin studded with diamonds was made Feb 16 by **Lt Col Frank W Parker** of the Chicago Ordnance District.

✪

Folke Richards, an engineer for seventeen years with the **Westinghouse Electric & Mfg Co,** has been appointed

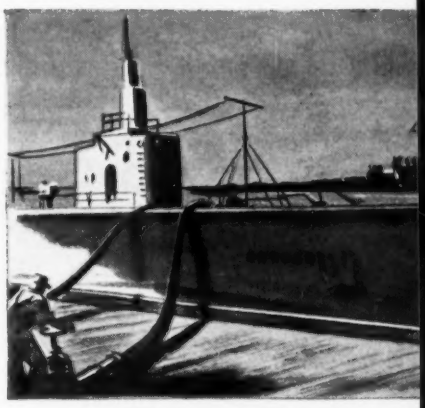
Rubber WILL RIDE TO VICTORY ON THE SEVEN C's

THE "Seven C's" are ***Conservation,*** to salvage all rubber for re-use; ***Care,*** to make what we have last longer, do more; ***Cooperation,*** in use and allocations; ***Compounding,*** to produce the best mechanical rubber goods within the limits of supply; ***Construction,*** of fabric and reinforcement so that less rubber may do more; ***Collaboration,*** of the entire Rubber Industry for the good of all; ***Courage,*** to pursue research and development relentlessly.

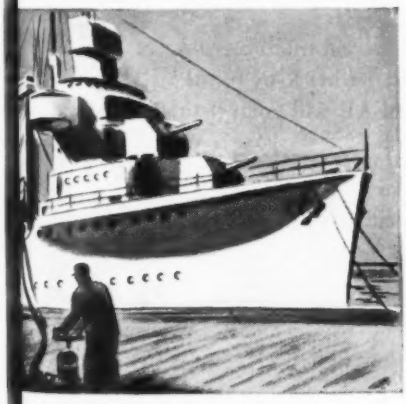
The entire mechanical rubber industry is applying its collective ingenuity, experience and skill from laboratory to shipping platform with results which, at times, may look like miracles to anyone unfamiliar with the sustained research which is an inherent part of the story of Rubber.

In a single airplane there are hundreds of rubber parts, including hose for fuel, oil lines and hydraulic controls; packings, and vibration dampeners.

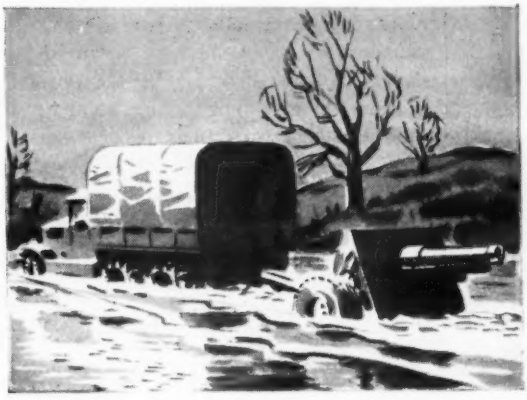
Tanks need rubber at many points—rubber that will withstand heat, cold, oil, abrasion.



Submarines require acid-resisting rubber for battery compartments; other kinds of rubber in gaskets, mountings, and for scores of special applications.



Thousands of pounds of rubber go into every warship at hundreds of places from propeller shaft to gun decks and fire control tower.



Trucks and gun carriages require rubber for hydraulic brake parts, for shock absorption, and for other vital uses.

50th YEAR OF RESEARCH

THE half century mark now reached at MANHATTAN finds the thousands who work within its several plants too busy to take full note of this milestone in a long record of achievements. Among these are Compensated Power Transmission Belting in which all plies have equal stresses; the Extensible Tip for prolonging the life of endless belts; the Homoflex hose construction principle which increases the flexibility and multiplies the life of rubber hose—often many times; Radio-Active treated fire hose that resists mildew; first to adapt synthetic rubber in oil-proof rubber products; Vibration Dampener Bushings for portable grinding wheels.

These are but a few of the MANHATTAN developments which are contributing to conservation of rubber by prolonging service life, and to greater production.

THE MANHATTAN RUBBER MANUFACTURING DIVISION
of RAYBESTOS-MANHATTAN, INC.
EXECUTIVE OFFICES PASSAIC, NEW JERSEY

Your Blueprint for

MORE POWER

starts with

OAKITE CLEANING

. . . De-Scaling Transformer Cooling Coils Safely, Easily

Because of the greater loads under which war plants operate today, power transformers are working overtime. Result is lime-scale deposits build up MORE RAPIDLY in transformer cooling coils.

That is why it is so essential to remove these deposits promptly whenever required. You can do this EASILY, as well as SPEEDILY, by using SAFE, FAST-WORKING Oakite Compound No. 32. Simply circulate recommended solution through coils as directed, then neutralize and rinse. Heat transfer efficiency is fully restored . . . temperature of cooling water upon discharge from transformers is uniformly cool.

Helpful Wartime Service Yours FREE!

Take advantage of FREE Oakite Wartime Technical Service on this and 40 other essential plant maintenance jobs. NEW DIGEST gives you complete details. Write for it TODAY!

OAKITE PRODUCTS, INC.
23 Thames Street, New York, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized cleaning*

Buy Bonds for Victory

MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

manager of engineering in the company's gearing department at the Nuttall works, Pittsburgh, Pa. Mr Richards was graduated in 1921 from the **Institute of Technology at Katerineholm, Sweden** with a mechanical engineering degree. . . . The War Production Board has amended a revocation order of last January 6 whereby permission will be granted for completion of permanent work inside the first cofferdam of the **Bluestone reservoir flood control** project near Hinton, W. Va. . . . **Chas T Main, Inc.** 201 Devonshire St, Boston, Mass., announced the election of **W M Hall** as a director of the corporation. . . . Through an error, the cut supplied to POWER (Item 1, Mid-December, 1942, p 114) does not illustrate Tal's Prestal pipe bender.

✪

Approximately **70 types of brushing wheels** have been assembled for a permanent exhibit in the **Smithsonian Institution** at Washington by the **Osborn Mfg Co,** Cleveland, Ohio. The exhibit shows the development of brushing wheels during the last 50 years. . . . The engine of a modern 400 mile-an-hour fighter plane "breaths in" about **seven tons of air,** nearly six times its own weight, every hour. . . . At a recent party attended by practically all of the 850 employees of the **Roller-Smith Co,** veterans having five or more years of continuous service were awarded service emblems. **Seven designs distinguished** the comparative newcomers who joined the company five years ago from their predecessors with one star being added for each five years of service.

✪

D Robert Yarnall, co-founder and chief engineer of Yarnall-Waring Co, former director of American Engineering Council and currently director and vice-president of the American Friends Service Committee, was one of those named by Mayor Samuel of Philadelphia, Pa., as part of a commission on city planning to map postwar Philadelphia, Pa.

✪

Chester F Conner, manager distributor sales, industrial products division, the B F Goodrich Co, has been appointed to the staff of advisers of the mechanical rubber goods in the **Office of Rubber Director,** War Production Board, Washington, D. C. . . . **"The American Engineer and the War Effort"** was the subject of **Dr Adrey A Potter,** dean of engineering at Purdue University, and chairman of the National Advisory Committee on War

Just Brush or Spray on

BRICKSEAL

For More Lasting Refractory Linings

If your refractory lining has developed minute cracks or fissures in its brick or joints . . . BRICKSEAL will correct this condition.

If your refractory lining is in good condition — BRICKSEAL will keep it that way.

BRICKSEAL, a semi-plastic, highly glazed, monolithic coating, protects refractory linings when they are forced to undergo rapid changes in temperature. Once on, it will not crack, peel, bloat or blister and . . . combustion gases cannot injure it.

• **SEE A BRICKSEAL SAMPLE . . .** and find out how BRICKSEAL makes a wall last longer . . . how it cuts down maintenance. Write or telephone today for a BRICKSEAL representative. No obligation.

BRICKSEAL REFRACTORY CO.
1029 CLINTON ST.
HOBOKEN, N. J.

Simplify MOTOR CONTROL MAINTENANCE

SQUARE D makes it easy by providing complete illustrated instructions with every starter

● Whether they're "old hands" or new on the job, men who do the electrical maintenance work like two things about Square D motor control.

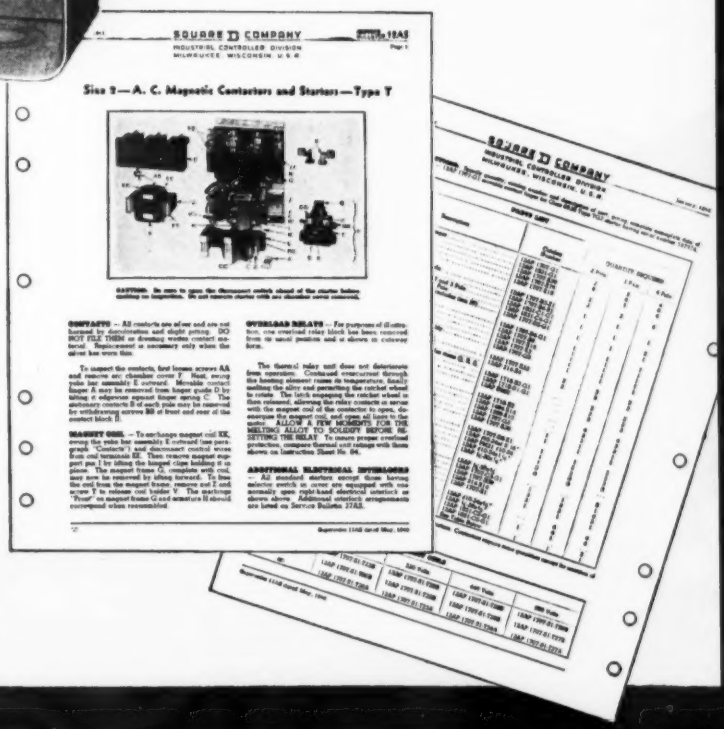
First—simple, understandable servicing instructions are included with every starter.

Second—all renewable parts of Square D motor starters can be inspected or replaced, using only a screwdriver and without disturbing any external connections.

Both are important factors, especially during these days of all-out production. One eliminates guesswork. The other saves precious time.

● Top operating efficiency and long life of electric motor starters depend largely upon regular inspection and occasional servicing. For best results, follow the manufacturer's instructions.

Square D provides these instructions in the form of a "service bulletin." On the front of this bulletin appear the maintenance instructions and a partially "exploded" photograph of the starter with key letters and arrows to identify the parts. On the back is given the photograph key letter, description, catalog number and quantity required of each part. Complete ordering instructions are given, making it a simple matter to order replacement parts, if necessary.


SQUARE D COMPANY
INDUSTRIAL CONTROLLER DIVISION
MILWAUKEE, WISCONSIN, U.S.A.

Size 2—A. C. Magnetic Contactors and Starters—Type T

SQUARE D COMPANY
INDUSTRIAL CONTROLLER DIVISION
MILWAUKEE, WISCONSIN, U.S.A.

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

KOLLSMAN INSTRUMENT DIVISION, ELMHURST, NEW YORK

IN CANADA: SQUARE D COMPANY CANADA LIMITED, TORONTO, ONTARIO

MINIMUM CRITICAL MATERIALS

. . . in this COAL HANDLING SYSTEM!

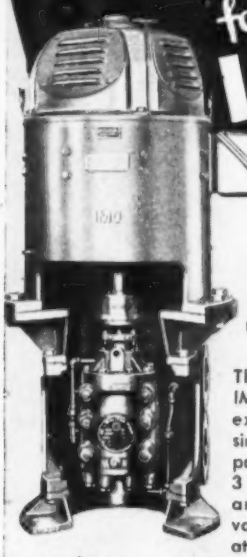
Shown above is one typical arrangement of the units in this B-B Coal Handling System.

Write us today for complete details.

Designed to fill today's needs for handling coal in either new installations or oil-coal conversion, this system offers numerous advantages. Send for full information.

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.
MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

There is always room for an IMO



The De Laval-IMO Oil Pump is exceptionally simple and compact. It has only 3 moving parts and no gears, valves or separate bearings. Internal parts are easily accessible. Any grade of oil is delivered at any rate of flow against any pressure and without pulsation. The pump can be coupled to a standard speed motor or turbine.

Ask for Publication I-105.

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

HERCULES
Seamless Copper
FLOATS

GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

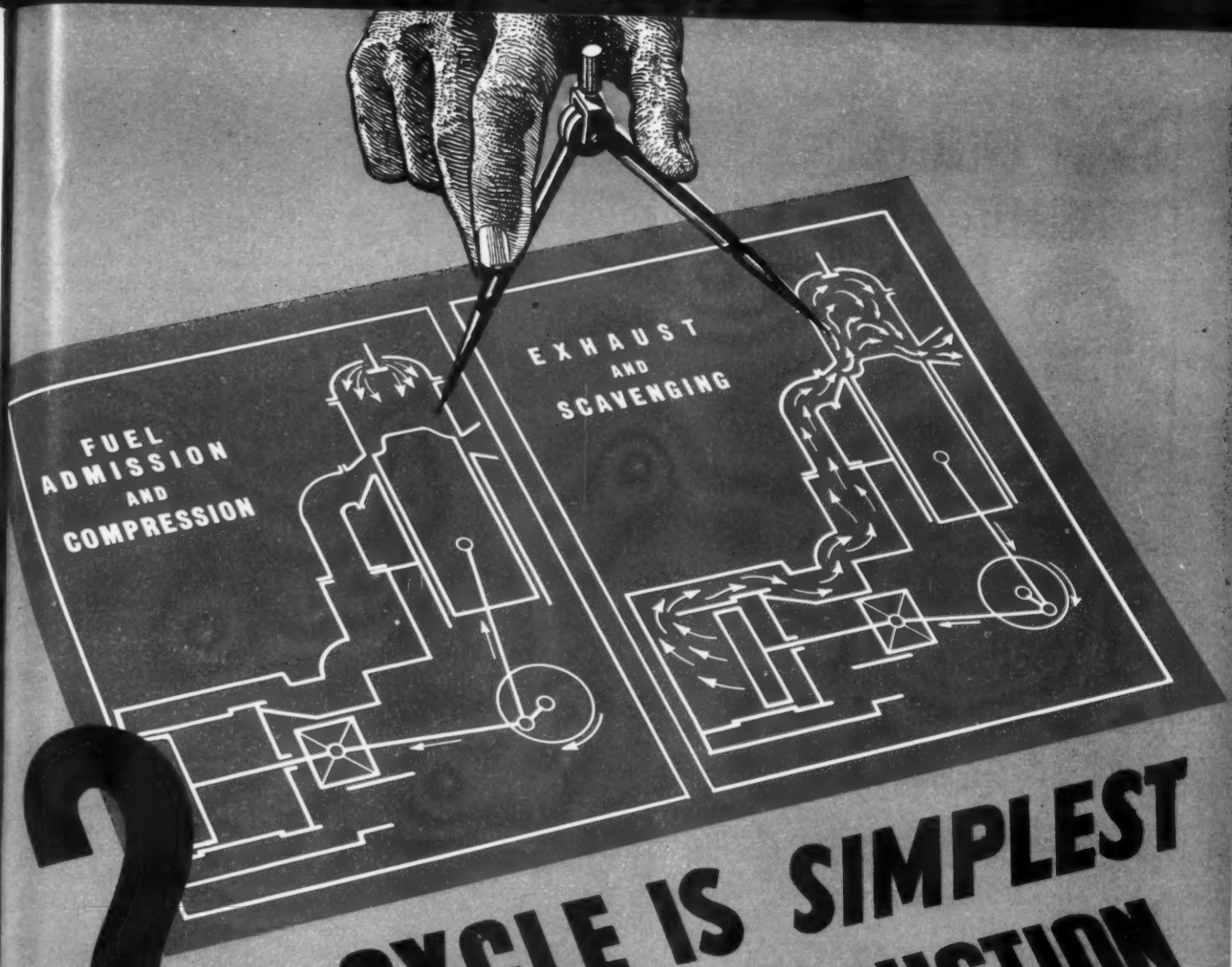
Training in Engineering, Science and Management, when he spoke before the **Washington Award Commission** on February 24. Dr Potter appeared before the commission to receive the "Washington Award for 1943," recently voted him for **"distinguished leadership** in engineering education and research, and patriotic service in mobilizing technical knowledge for victory in war and peace."

✪

The Army Needs Ideas—From civilians, sailors and soldiers—a release from The Engineer School at Fort Belvoir, Va., states: "The Corps of Engineers would like useful ideas which might be of use in the effective prosecution of the war. Some of the subjects included are bridges, construction, drafting, equipment, machines, maintenance, photography, **power,** safety, training, and numerous other fields. The release states that no useful idea is too small to report. Every idea is judged by competent experts, every suggestion is copied and submitted to the critics without any indication of its source, and approval does not depend on rank or influence." Send your ideas to the **Corps of Engineers, The Engineer School,** Fort Belvoir, Va. . . . After three and a half months with the War Production Board in Washington, **Fred W Climer** returned to the **Goodyear Tire & Rubber Co** recently as assistant to **E J Thomas,** president. Mr Climer was personnel director at Goodyear from Dec 1, 1938 until loaned to the Government last October 19. . . . **Capt Nelson W Pickering,** USNR, has been ordered to report for active duty in the United States Navy and accordingly has resigned as president of **Farrell-Birmingham Co, Inc,** of Ansonia, Conn., and Buffalo, N. Y. Before coming to the Farrell-Birmingham Co in 1919, Captain Pickering served for fifteen years in the Navy.

✪

The National Nominating Committee of the **American Institute of Electrical Engineers** has nominated the following official ticket of candidates for the offices becoming vacant Aug 1, 1943. For president, **Nevin E Funk,** vice-president in charge of engineering, Philadelphia Electric Co, Philadelphia, Pa.; for vice-presidents, **W E Wickenden,** president, the Case School of Applied Science, Cleveland, Ohio (Middle Eastern District); **C W Ricker,** professor and head of School of Electrical Engineering, Tulane University, New Orleans, La. (Southern District); **L A**



2-CYCLE IS SIMPLEST ENGINE CONSTRUCTION

NO VALVES TO GRIND

Simplicity of design — few moving parts — are tremendous advantages in mechanical equipment. The 2-cycle engine possesses these great advantages over the 4-cycle. It has an uninvolved fuel injection system — no exhaust valves; it represents the extreme of simplicity in operating principle.

Note the simplicity of CLARK Super-2-Cycle operation, diagramed above. Every up-stroke compresses a fuel mixture. Every down-stroke is a power stroke. There is no "waste stroke", to cut power in half and double wear and tear. Scavenging with 26% excess air is instant and thorough.

Other basic advantages in the CLARK 2-Cycle are: 1. Greater Fuel Economy; 2. Less Wear; 3. Smoother Operation; 4. Fewer Man Hours; 5. Lower Oil Consumption; 6. Lower Installation Cost.

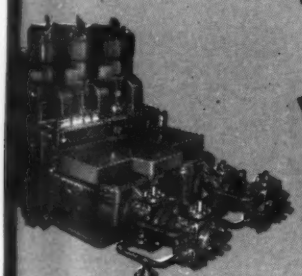
Investigate these claims. Our engineers are at your call.

CLARK BROS. CO., INC. . . . . OLEAN, NEW YORK, U.S.A.

Export Office: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Tex.; Chicago, Ill. (122 S. Michigan Ave.); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5715 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1., London; Avda Roque Saenz Pena 832, Buenos Aires.

AFFILIATED COMPANIES: Dresser Mfg. Co., Bradford, Pa.; Pacific Pump Works, Huntington Park, Calif.; Bryant Heater Company, Cleveland, Ohio.

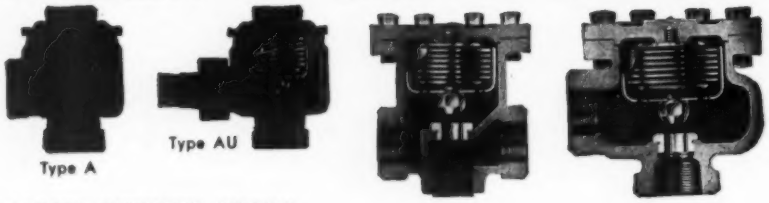
CLARK Super-2-Cycle



CLARK 3-Cyl., 300 H. P. "Super-2-Cycle" Angle Compressor

CLARK 8-Cyl., 800 H. P. "Super-2-Cycle" Angle Compressor

DON'T OVERLOOK THIS POSSIBILITY FOR INCREASED PRODUCTION



MANY REPORTS PROVE THAT THESE NICHOLSON INDUSTRIAL TRAPS BOOST EFFICIENCY OF HEATED UNITS AS MUCH AS 30% THRU BETTER CIRCULATION OF STEAM

Two to six times greater discharge capacity. Quick automatic action. No air-binding . . . no dribbling . . . no freeze-ups . . . no water logging . . . no adjustment. Frequent intermittent discharge induces rapid heat transfer in water heaters, pipe coils, kettles, driers, unit heaters, etc. Four types; sizes ¼" to 2"; pressures to 300 lbs.

Bulletin No. 242—W. H. NICHOLSON & CO., 125 OREGON ST., WILKES-BARRE, PA.

NICHOLSON *Traps*

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼▼▼

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

BE PREPARED!

to Store More Coal with Sauerman Equipment

WAR conditions demand that adequate stockpiles be created now. Coal production and transportation must be spread more evenly. "Reserves for Safety" is the order of the day.

You can safely pile coal higher on your present storage space, any shape or size, with a Sauerman Power Drag Scraper.

Sauerman Equipment stores and reclaims safely, rapidly, cleanly, for only a few cents per ton. Builds a homogeneous pile in compact layers—free of combustion hazards. Operates with minimum of champing across pile and avoids dirt and dust of heavier equipment.

Whether your problem requires handling 10 tons or 500 tons per hour we give you a machine that meets your needs economically—that is trouble-proof and easy to operate.

Sauerman Advantages:

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POWER DRAG SCRAPERS FOR STORING AND RECLAIMING

Bingham, assistant professor of electrical engineering, University of Nebraska, Lincoln, Nebr. (North Central District); **J M Gaylord,** chief electrical engineer, Metropolitan Water District of Southern California, Los Angeles, Calif. (Pacific District); and **W J Gilson,** general manager, Eastern Power Devices, Ltd, Toronto, Ont., Canada (Canada District). For directors: **C M Laffoon,** engineering manager, A C Generator Eng Dept, Westinghouse Electric & Mfg Co, East Pittsburg, Pa.; **C W Mier,** engineer, Southwestern Bell Telephone Co, Dallas, Texas, and **S H Mortensen,** chief electrical engineer, Allis-Chalmers Mfg Co, Milwaukee, Wis. For national treasurer, **W I Slichter,** professor emeritus of Electrical Engineering, Columbus University, New York, N. Y. These official candidates, together with any independent nominees that may be proposed later will be voted upon by the membership at the coming election this spring.

✪

The Manhattan Rubber Division of Raybestos-Manhattan, Inc, Passaic, N. J., will this year celebrate its fiftieth anniversary of its founding as the Manhattan Rubber Mfg Co. The original company was incorporated on **Oct 28, 1893,** during the panic which lasted from 1893 to 1897. **Harry E Smith** is general manager, **John H Matthews** is assistant general manager, and **Charles T Young,** factory manager.

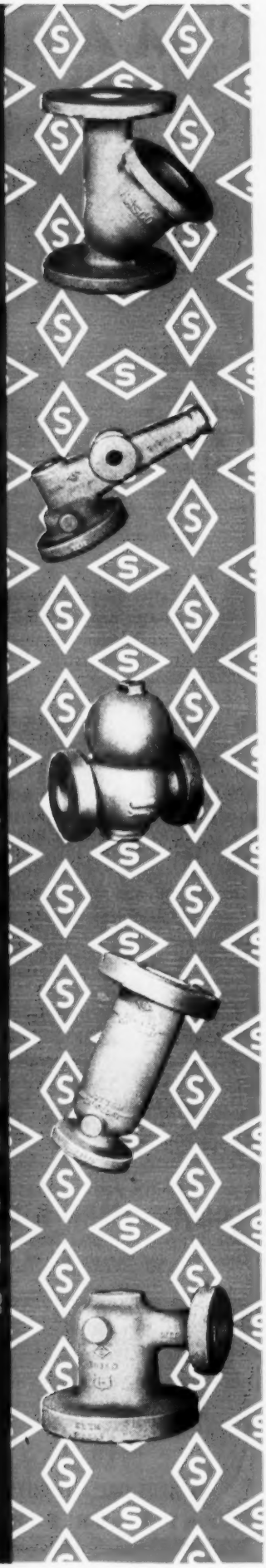
✪

Richard P Brown, chairman of the board of the **Brown Instrument Co** of Philadelphia, and vice-president of **Minneapolis-Honeywell Regulator Co,** has been elected a member of the board of trustees of the Drexel Institute of Technology. A former Drexel student, Mr Brown is a member of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, and for the past year has been regional consultant for the Defense Plant Corp in a wide area surrounding Philadelphia. . . . **The Weather Design Conditions Committee** of the ASHVE has prepared a full year of record data obtained at various selected locations in Washington, D. C. They hope an analysis of these data will be made early this year to show temperature variations which occur within a given locality. It is felt that the information obtained may have an important bearing upon the present basis of fuel rationing, which is predicated to a large extent for quantitative measure upon the degree day

WORTH LOOKING FOR

Your eyes will tell you that the Sivyer S on a casting stands for clean, smooth finish. Your measurements will show that castings bearing this mark are true to dimensions, free from warp or malformation. Your machine shop will find that Sivyer castings machine uniformly and economically. Your metallurgist's test will reveal their internal integrity . . . these have been the qualities of Sivyer Steel Castings for more than thirty years. They will continue — this we promise — to be distinguishing qualities whether we are producing under war's pressures or for all the products, new and old, which peace will bring.

SIVYER STEEL CASTINGS



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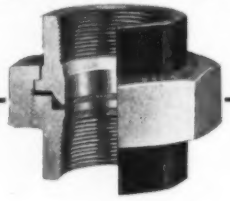
MILWAUKEE S CHICAGO S

"MARK"
AMERICA'S FIRST
STEEL UNION



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WORKING PRESSURE, POUNDS PER SQ. INCH

	STEAM OR HOT OIL			COLD WATER OIL OR GAS NON-SHOCK
Black or Galvanized	500° F	550° F	600° F	
	1150 lbs.	600 lbs.	400 lbs.	2000 lbs.

The MARK A. A. R. forged steel union after 30 years serving industry still remains America's first and foremost steel union because of these exclusive features:

EXTRA HEAVY ENDS and NUT
PERMANENTLY LUBRICATED and RUST-PROOFED NUT THREADS
BRONZE SEAT COMPLETELY FUSED TO THE STEEL and THEN MACHINED and COLD ROLLED
SAFETY FACTOR AGAINST RATED WORKING PRESSURES APPROXIMATELY 5 to 1

In addition to these exclusive features MARK UNIONS interchange part for part with PETRO, HYDRO, and all other A. A. R. UNIONS and are priced in line.

Let PETRO, HYDRO, and MARK—the three gallant guys of steel—work out your union troubles.

If you are engaged in essential war work, order by trade name from your jobber.

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EVANSTON, ILLINOIS
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which takes into consideration the temperature for a locality as a whole. T H Urdahl, chairman of the committee, is a member of the Committee on Research.

✪

J C Runyon, a consulting engineer of Falls Church, Va., writes: "In your January, 1943, issue the item **'Here's an argument,'** on page 132, has a typographical error in the third paragraph. This should read 'using 440 volts is as senseless as the old experiment of using three 110-**220** single-phase systems. . . .'" Thanks, Mr Runyon, for your correction.

✪

Commendations on the performance of refrigerating equipment aboard the USS Marblehead were received by the **Frick Co** some weeks ago. The telegram read: "It has been brought to my attention that one of your ice-making plants installed in the **USS Marblehead** played an important part in giving relief and comfort to a number of the ship's company who had received serious burns in fires resulting from enemy action. This bureau takes pleasure in extending thanks to all of you who helped build this excellent equipment for the Navy," **E L Cochrane, Rear Admiral, U S Navy, Chief of the Bureau of Ships.**

✪

Latest aid to engineers is a 20-page booklet entitled, **"Timely Wartime Tips on Fluorescent Maintenance",** published by **Sylvania Electric Products, Inc,** Salem, Mass. This colorful little booklet presents advice showing how to help you prevent fluorescent trouble before it starts, how to maintain and conserve your fluorescent equipment, how to obtain efficient and economical operation. In short, the ways and means of getting the most life of your present fluorescent installations. **Copies can be obtained by** writing to the engineering department of the company mentioned. . . . **The George S May Co** has designed and is issuing Shift-O-Graph, a rotating slide-rule type perpetual **work shift schedule.** Provides for four plans: (1) three crews rotating over two shifts; (2) same as (1) except that crews do not rotate; (3) four crews rotating over three shifts; and (4) same as (3) except that crews do not rotate. Plans (2) and (4) use a swing shift. **Shift-O-Graphs will be furnished** free to executives requesting them on their company letterhead. Address the George S May Co, 2600 North Shore Ave, Chicago, Ill.

SCHOOL DISTRICT REPORTS
"2 to 4 times longer furnace life" . . . *using* . . .
ADAMANT
FIRE BRICK CEMENT

Considerable savings in boiler maintenance costs were made by this user when a change was made to Adamant for laying up boiler bridge walls and side walls. Take advantage of Adamant's possible savings in labor and materials costs in your boiler room . . . savings that result from the high bonding strength of Adamant proven by impartial laboratory tests to be 800 lbs. per sq. in. at room temperature, 1270 lbs. per sq. in. at 2600° F. *"Its strength increases as the temperature rises".* Send today for literature.

ADAMANT has a P.C.E. of over 3000° F.

BOTFIELD
REFRACTORIES COMPANY
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ROCKWELL
BLAST
GATES

LASTINGLY AIR-TIGHT . . .

Tight closure . . . accurate setting . . . long-wearing design . . . easy operation . . . these are some of the Rockwell features that prevent air loss, save money, and provide the best blast gate investment.

Rockwell Blast Gates are made in all types: Slide Kwikleen, Wafer, Pull and Butterfly; in sizes from 1-in. up to 48-in.; with lever, handwheel, or chain wheel control; with screwed or flanged ends.

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W. S. ROCKWELL COMPANY
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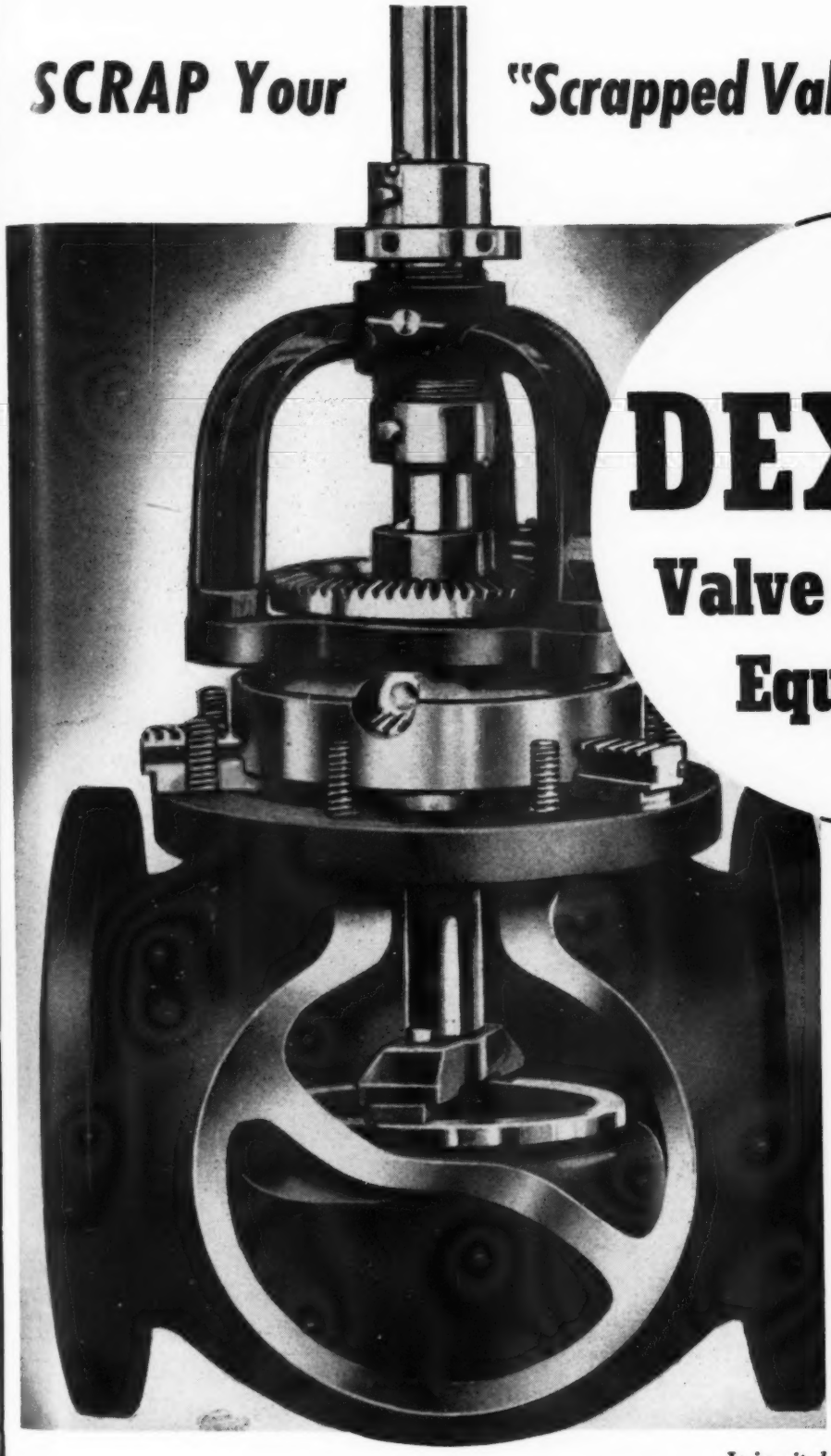
SCRAP Your "Scrapped Valve" Problems



with DEXTER Valve Reseating Equipment

Today, with new valves and parts so hard to obtain, it almost seems like a crime to scrap old valves. And it *is* a crime to scrap them, when they can be reconditioned — made as good as *new* — with Dexter Valve Reseating Equipment.

In just a short time, any mechanic using Dexter Valve Reseating Equipment can turn a leaky valve into a lucky valve, a wasteful valve into a highly *efficient* one by making a valve seat and disc or gate *absolutely tight.* And it makes no difference what kind of metal a valve is made of . . . Dexter Cutters are available for monel, stainless, stellite, bronze, brass.

It is *vital* to our country to preserve valves and conserve power . . . and it is very *economical* for your company, too. Send for further information about Dexter Valve Reseating Equipment, today.

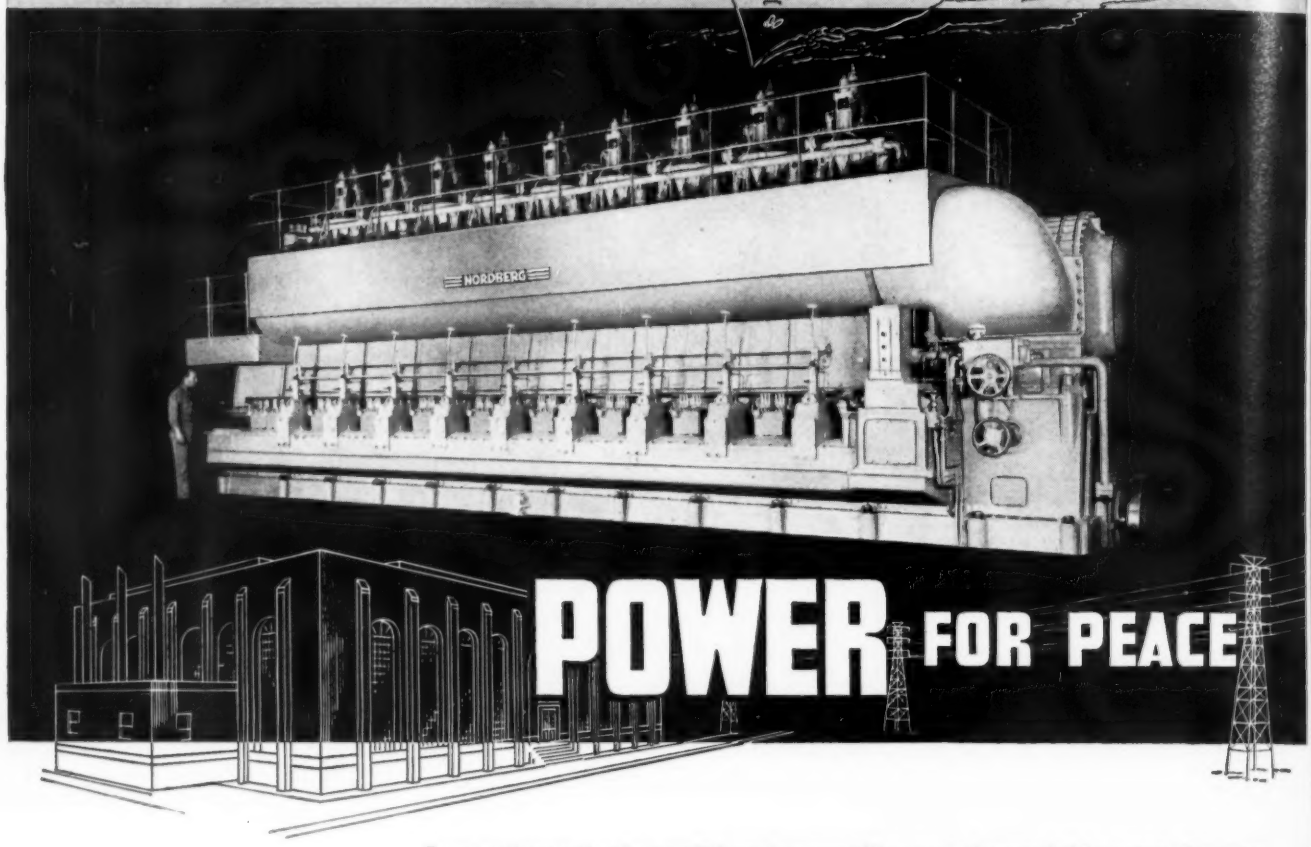
CAPACITIES: *Globe valves, ¼" to 14"; Gate valves, 1½" to 48"; Pump valves, 1½" to 15".*

DEXTER Valve Reseating Machines

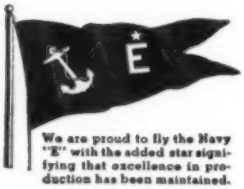
THE LEAVITT MACHINE COMPANY

104 EAST RIVER ST., ORANGE, MASS.

POWER FOR WAR



POWER FOR PEACE



We are proud to fly the Navy "E" with the added star signifying that excellence in production has been maintained.

In meeting today's conditions imposed by war, dependable power is more essential now than ever before. Here again Nordberg engines are demonstrating the advantages of dependable Diesel power just as they have during many years under peacetime conditions. Included among the many users of Nordberg Diesels serving the war effort are installations at vital air bases, at mines producing strategic metals such as aluminum, copper, lead and zinc, wartime chemicals, oil pipe lines and in industrial, public utility and municipal power plants serving every conceivable industry. Many of the fastest cargo and naval supply ships afloat are powered with Nordberg engines. In every power application you can depend on Nordberg Diesels for reliability and economy.

Don't say DIESEL—
say NORDBERG

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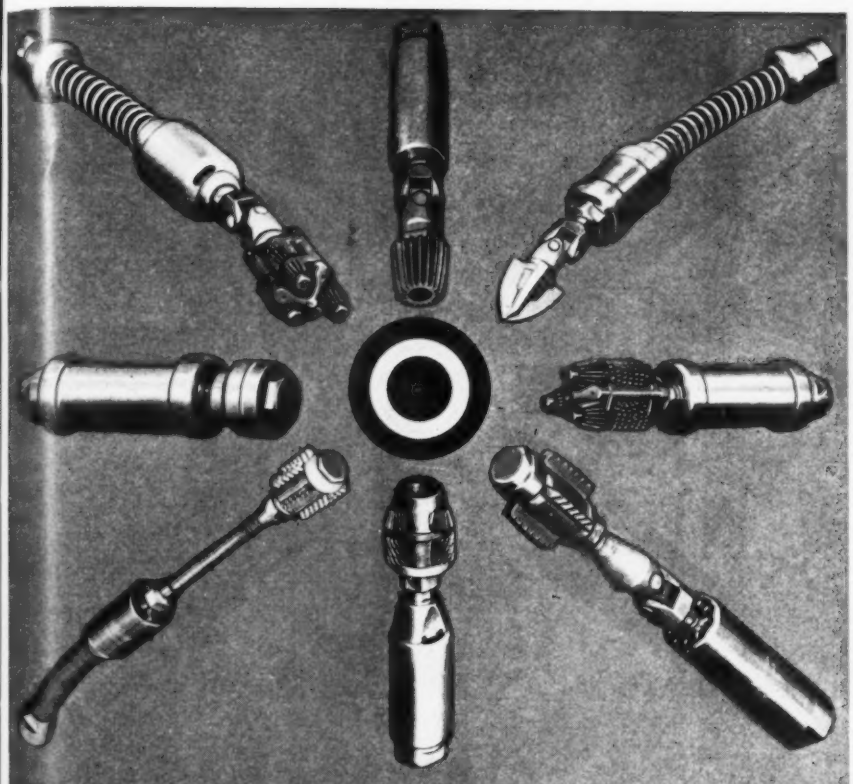
NORDBERG
DIESEL ENGINES



YOU CAN KEEP UP-KEEP DOWN WITH WILSON TUBE CLEANERS

Today, more than ever before, it is essential that boilers—like all other mechanical equipment—are maintained at maximum efficiency. Shutdowns for tube cleaning reduce plant production and improperly cleaned tubes necessitate more frequent cleanings. So, whenever a boiler *must* be cleaned it is sound business to always use a tube cleaner which operates at maximum efficiency and which does a *rapid* and *thorough* cleaning job. This will reduce the number of cleanings per year, will keep up-keep down and will increase production.

Wilson Tube Cleaners clean straight or curved ferrous or non-ferrous tubes of large or small diameter faster, better and more economically because they have more speed, more power and more efficiency built into them.

Write for the name of our representative nearest to you, or ask for a copy of our NEW 40-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

INVEST IN AMERICA! BUY WAR BONDS AND STAMPS!

THOMAS C. WILSON, Inc.

PIPE AND TUBE CLEANERS EXCLUSIVELY

THE WILSON BUILDING

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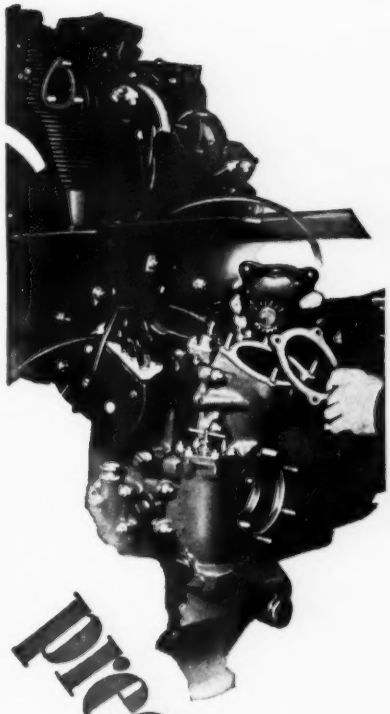

precision . . . quick

In close-precision aircraft adjustments . . . *quick* accuracy is insured by Laminum shims. From factory assembly to vital field servicing! Laminum shims (easily peeled precision brass laminations) are cut to your specifications.

Stock shim materials obtainable from mill supply dealers. (Write us for shim application folder and Laminum sample.)

Laminated Shim Company, Inc.

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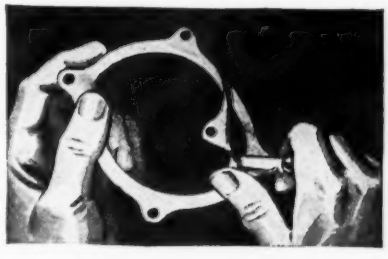
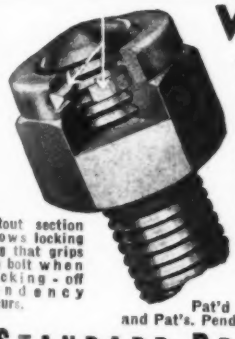


it's

LAMINUM

THE SOLID SHIM THAT *peels* FOR ADJUSTMENT



Cutout section shows locking ring that grips the bolt when backing-off tendency occurs.

WON'T SHAKE LOOSE!

True protection for all moving parts or reciprocating engines, pumps, generators, stokers, etc., "Unshako" is a simple, foolproof device you can depend on to G-R-I-P wherever vibration is the problem.

Saves maintenance time, reduces breakdown trouble!

For free samples and details, write—

Pat'd and Pat's. Pend.

UNSHAKO

Reg. U. S. Pat. Off.

SELF-LOCKING NUT

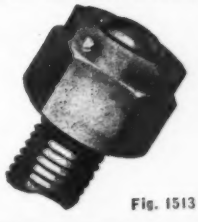


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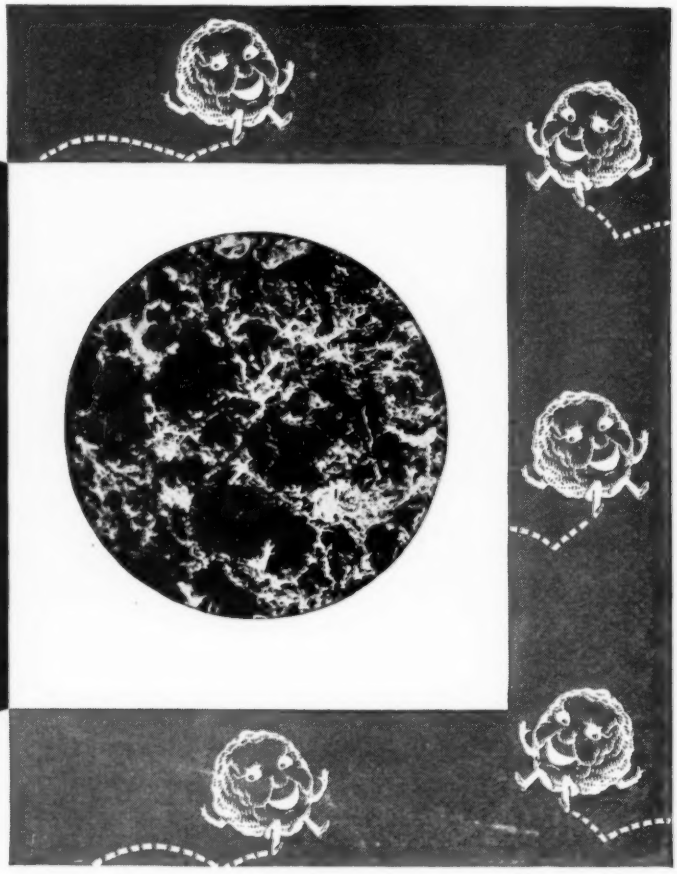
Fig. 1513

FACTS YOU MAY NOT KNOW ABOUT EAGLE MINERAL WOOL INSULATION

These dead air cells saved a million dollars!



You are *not* looking at a photo of the moon, but at a photomicrograph of a pinch of Eagle Mineral Wool Insulation, whose structure permits retention of an infinite maze of tiny air cells—air cells being the most efficient insulation known to science!

Not only one, but many millions of dollars have been saved to industry in recent years by the almost incredible efficiency of Eagle-Picher High Temperature Insulations which are made from Eagle Mineral Wool.

Eagle Super "66" Plastic Insulation

Most versatile insulation in the Eagle-Picher High Temperature line is Eagle Super "66" Plastic Insulation, an all-purpose cement. This product, for use on heated equipment up to 1800° F., trowels on easily, forming a tight one-piece coat.

High Thermal Efficiency

This unique insulation combines "springy balls" of Mineral Wool with long asbestos fibres to make a cement of great pliability and resilience. Dry coverage is 50-55 sq. ft. 1" thick per 100 lbs. Shrinkage is negligible from wet to dry. When used at temperatures up to 1200° F., Eagle Super "66" can be removed, remixed, reused!

Combats Rust, Corrosion

Furthermore — in itself non-corrosive, Eagle Super "66" actually helps prevent rust on the surface to which it's applied.

* * *

Write us for complete information on Eagle-Picher High Temperature Insulations, address Dept. P43. Current demand is great, but we are endeavoring to fill all orders without undue delay.

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Eagle Super "66" Plastic Insulation
Eagle Supertemp Blocks
Eagle L-T Felts
Eagle Blankets

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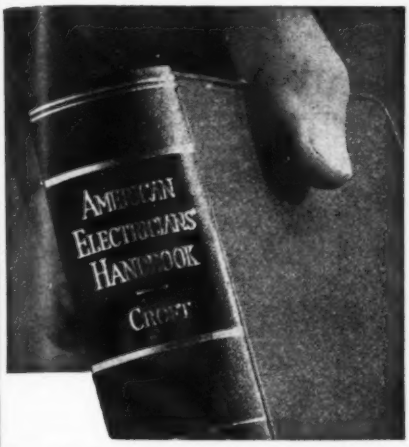

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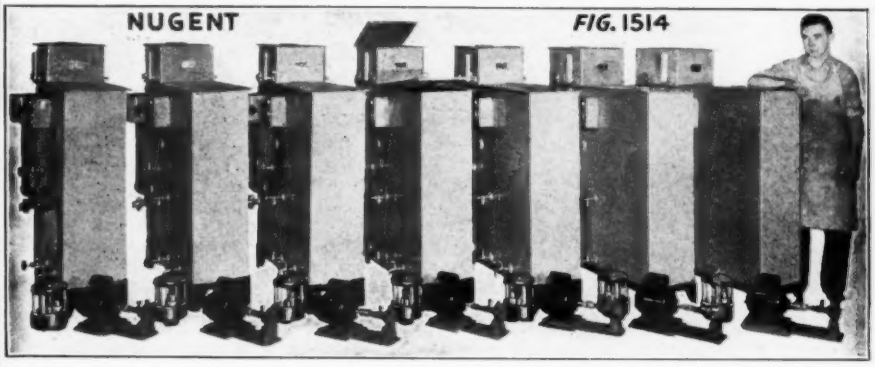

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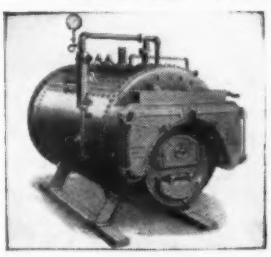

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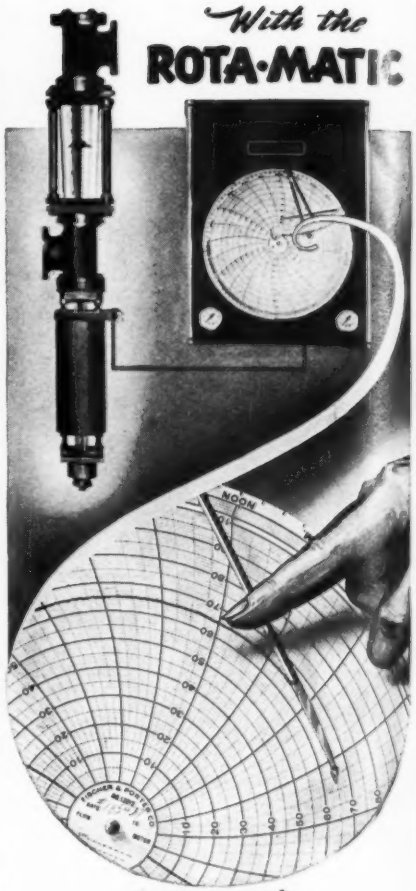

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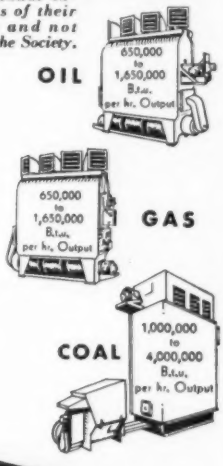

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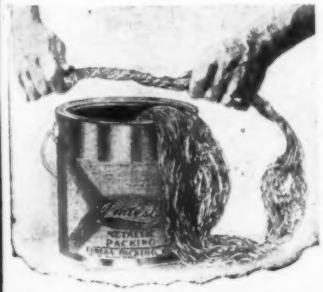

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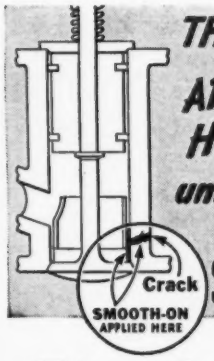

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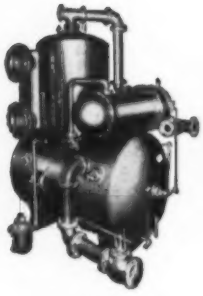

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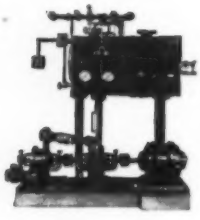

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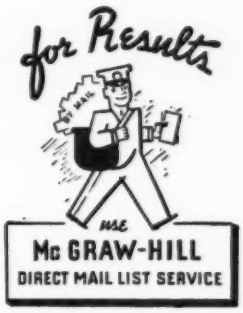

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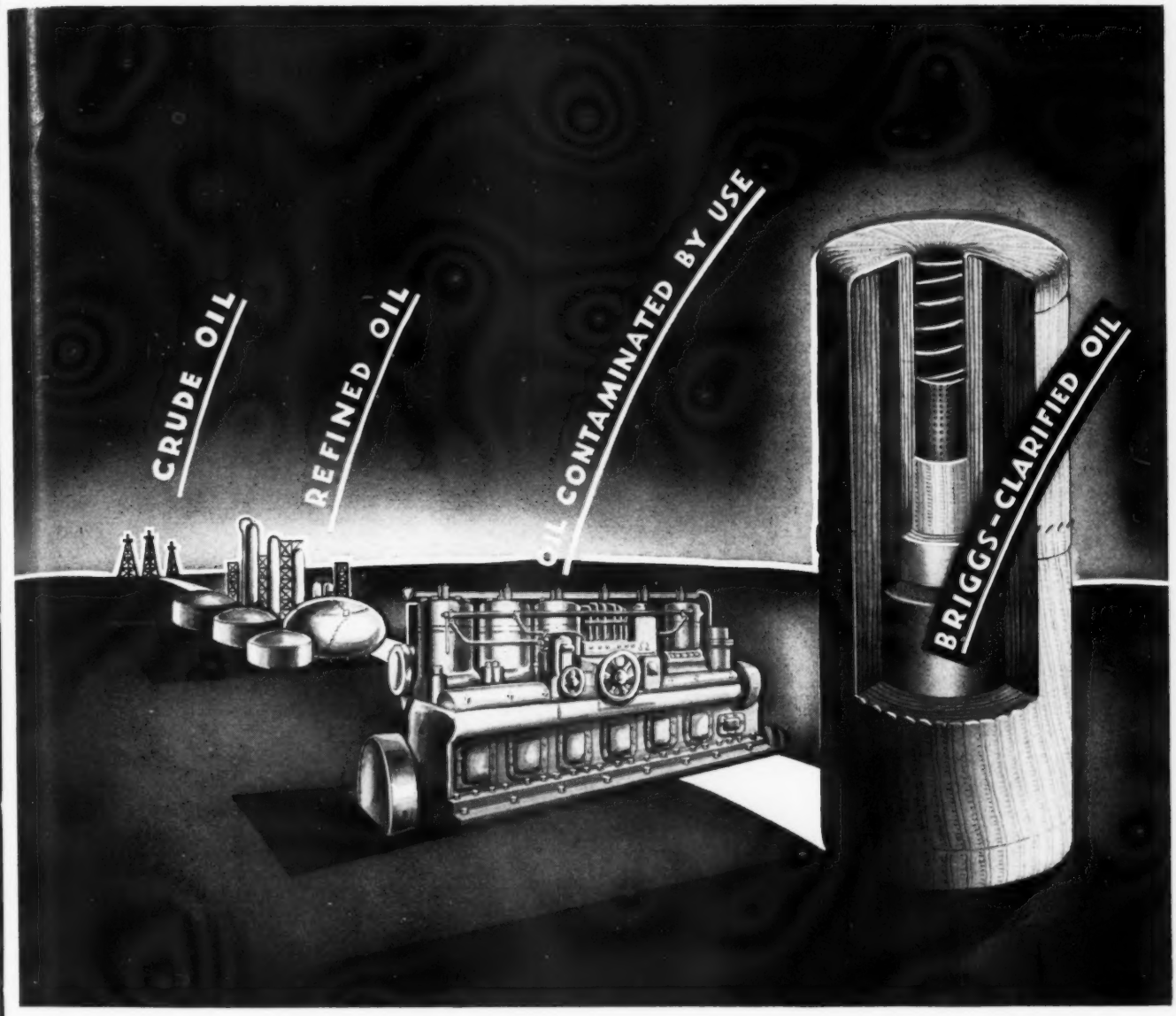

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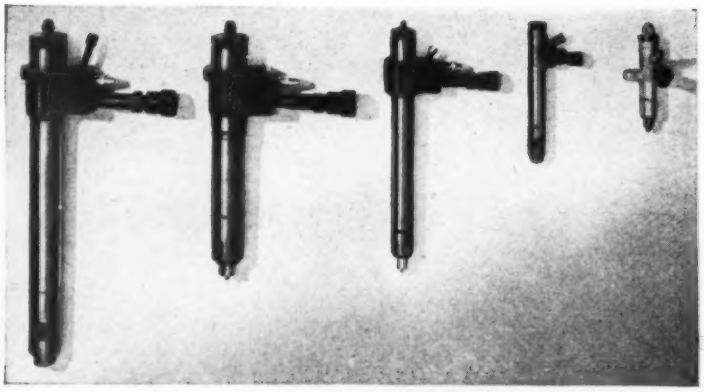

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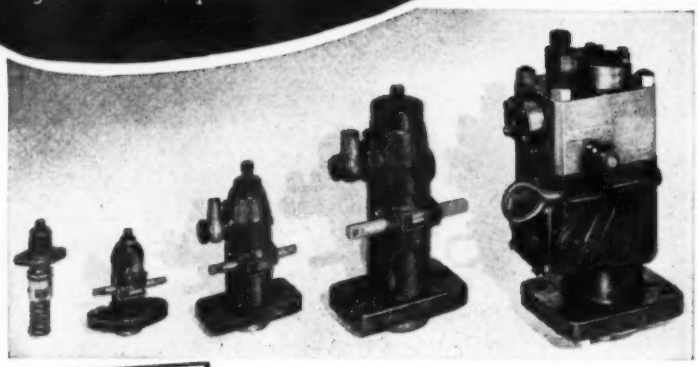

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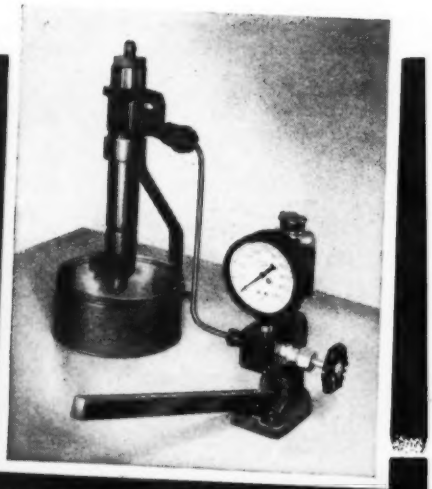

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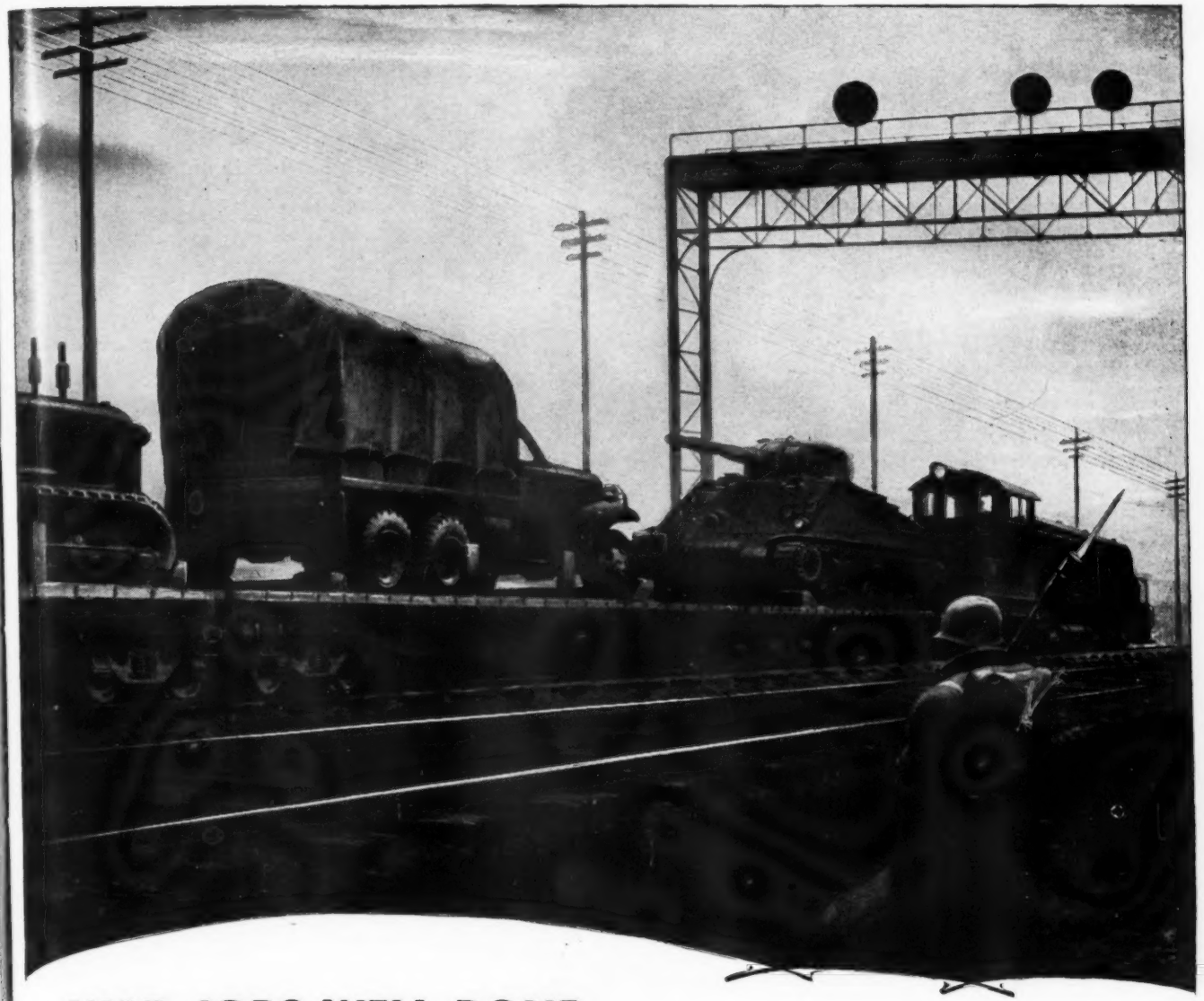

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SCARCELY anything you can name fills so many different war jobs as the General Motors Diesel engine. In tanks, landing boats, patrol boats, trucks, tractors and auxiliaries—everywhere sturdy dependability is needed—they're supplying power for our fighting forces.

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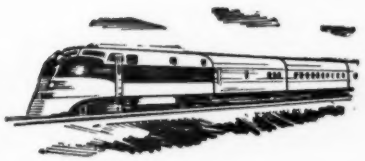

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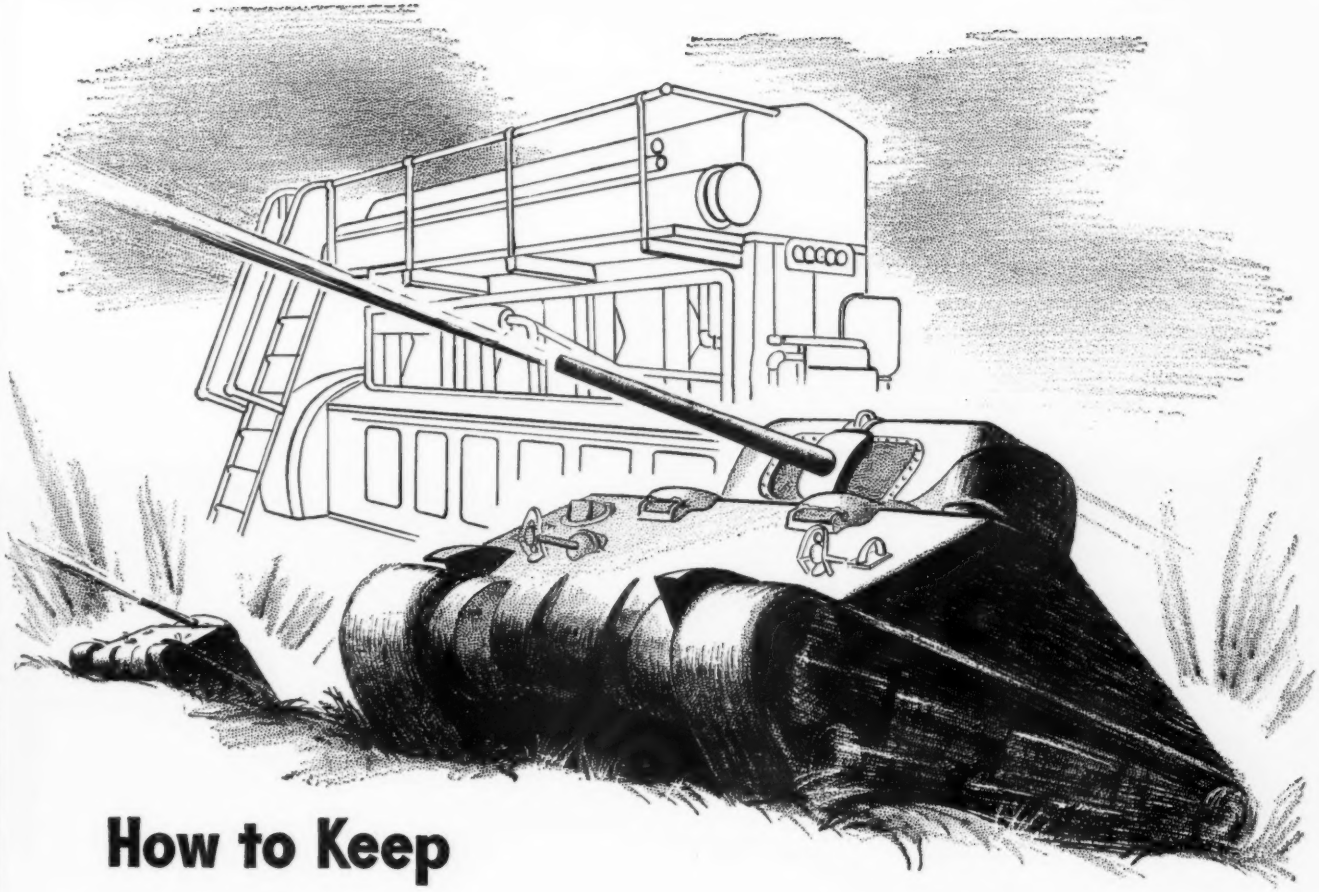

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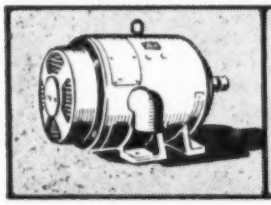
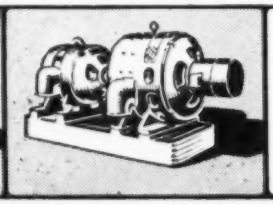
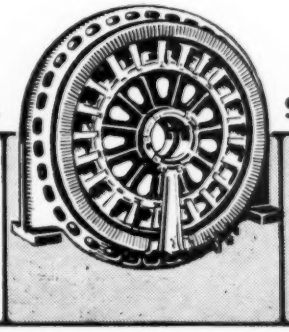
Write for the general Burke Booklet at the left, to get acquainted with a fine, reliable name in electric equipment.

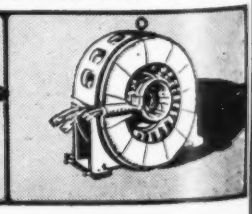
BURKE ELECTRIC COMPANY • ERIE, PA. SINCE 1891





D.C. Equipment to 1500 H.P. and 1000 K.W.
A.C. Equipment to 1500 H.P. and 1000 K.W.
M-G Sets to 1000 K.W.
Molded Bakelite Terminal Blocks





"This year we will advance"

—President Roosevelt

CLARAGE

Equipment

MAKES POSSIBLE *Greater* PRODUCTION FROM EVERY WORKER AND EVERY MACHINE

Is the Pace in Your Plant Slowed Up by Bad Air Conditions?

War is like a hog . . . it never gets enough!

This year with the United Nations on the offensive 'round-the-world, production demands on American industry are terrific.

Any practical way to increase your production should be given consideration. How about air conditions? Are they what they should be in your plants? . . . Impure air, the wrong temperature or humidity can slow up both workers and machines, can cause no end of absenteeism and product difficulty.

Our engineering and manufacturing resources are dedicated 100% to war needs. If you are engaged in vital work, and have any type of air-handling or conditioning problem, we can help you.

Write for the cooperation of the nearest Clarage engineer.

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

Faster Fueling

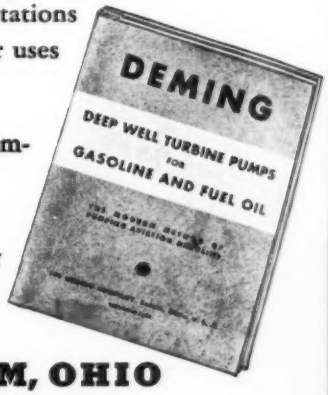
FOR TRUCKS, PLANES, AND INDUSTRY

the Deming Gasoline and Fuel Oil Pump

Successful performance in the rapid, dependable refueling of war planes and commercial planes is the forerunner of a wide demand for *Deming Gasoline and Fuel Oil Pumps* in other applications.

These turbine-type pumps incorporate features of design, construction, and operation which recommend them for fueling stations for trucks, tanks, and marine craft and for many other uses in refineries and industrial plants.

Deming Gasoline and Fuel Oil Pumps are shipped completely assembled and are easily installed.

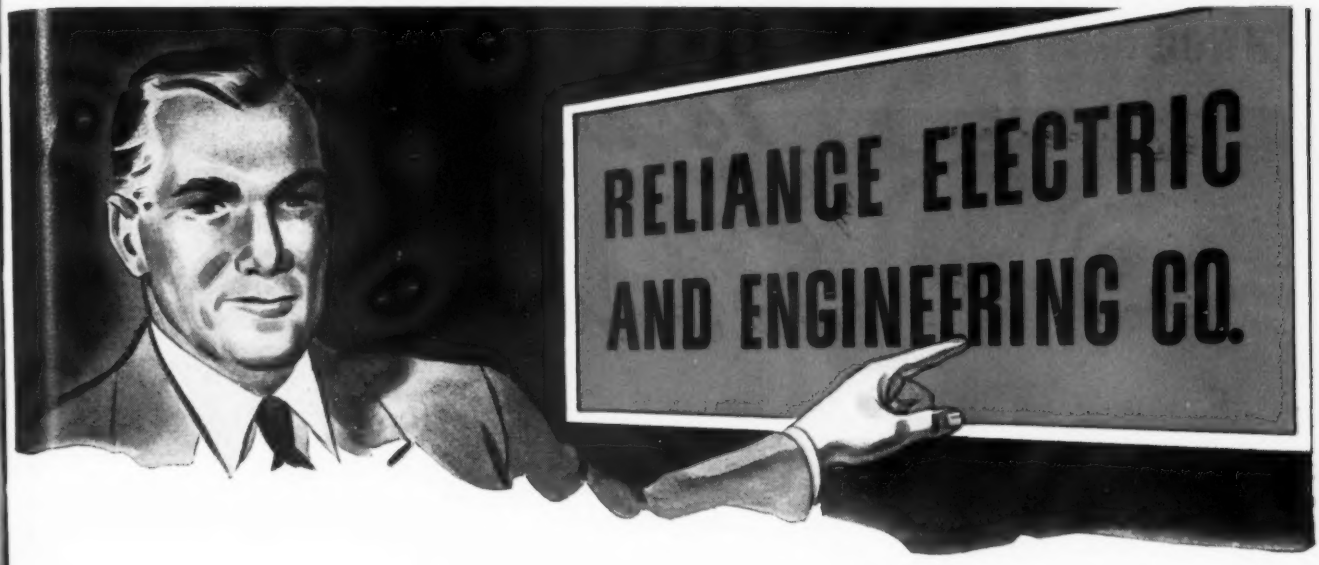


A portfolio of information about these pumps including factual data on other types of Deming Industrial Pumps is available upon request.

THE DEMING COMPANY • SALEM, OHIO

DEMING *Industrial* PUMPS

DEEP WELL TURBINES • CONDENSATION RETURN UNITS • SIDE SUCTION CENTRIFUGALS • DOUBLE SUCTION CENTRIFUGALS • SELF PRIMING CENTRIFUGALS • TWO-STAGE CENTRIFUGALS • VERTICAL SUMP PUMPS • CELLAR DRAINERS • SHALLOW AND DEEP WELL PUMPS AND WATER SYSTEMS • JET PUMPS AND WATER SYSTEMS • "TURBO-FLO" PUMPS AND WATER SYSTEMS • TRIPLEX PUMPS • ROTARY PUMPS • PISTON PUMPS



... I do mean "And Engineering"!

It is not enough, we think, to build top quality motors; rugged and smooth-running motors; motors of advanced design with unique protective features and low-maintenance advantages. This we do.

But, our job is not done until we have pooled our motor-building ability and engineering experience with your intimate knowledge of the operating requirements in your plant.

FOR MOTOR-DRIVE IS MORE THAN POWER. Properly applied, motor-drive can do *many things.**

Reliance Application Engineers—production minded men with broad experience in many industries—will welcome an opportunity to help you get the right answers to the question—*"What can we make the motor do besides supply power?"*

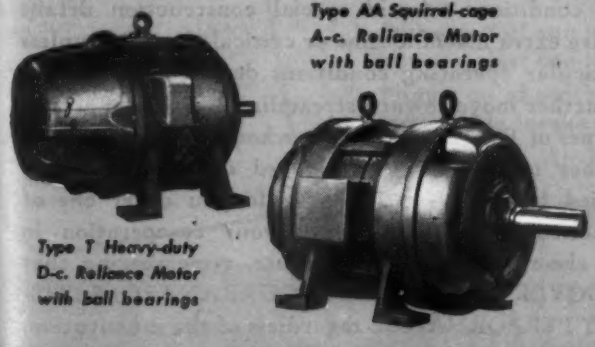
Just phone or write the Reliance office nearest you.

***Motor-drive provides within itself a means of:**

Speed Control	Reversing
Braking	Remote Control
Tandem Operation	Controlled Acceleration
Tension Control	Safety

Slow Speeds for inching, threading, inspection

Applying them to boost production and improve quality is APPLICATION ENGINEERING. That's our business.



RELIANCE A-C D-C MOTORS

RELIANCE ELECTRIC & ENGINEERING CO.
1088 Ivanhoe Road, Cleveland, Ohio

BIRMINGHAM • BOSTON • BUFFALO • CHICAGO • CINCINNATI • DETROIT • GREENVILLE, S. C. • HOUSTON, TEX. • LOS ANGELES • MINNEAPOLIS
NEW YORK • PHILADELPHIA • PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • SAN FRANCISCO • SYRACUSE, N. Y. • AND OTHER PRINCIPAL CITIES

Specify . . . . Standard . . Construction

☆

3 WAYS YOU CAN HELP

1

Whenever possible, specify control valves of standard design and construction. Avoid specifications that require extra machine work; such as, special flange facings, special or restricted port sizes, *except where operating conditions definitely require them.*

2

Do not specify the use of critical materials; such as, bronze, brass, copper, chrome, nickel and steel unless they are absolutely necessary to the satisfactory performance of the controller. *Specify steel bodies only when operating conditions demand it.*

3

Avoid changes in specifications after your order has been placed in production. *This necessitates extra handling of the order and further delays delivery.*

☆

★ AND SPEED VITAL WAR PRODUCTION . . . . . .

SAVE VALUABLE PRODUCTION TIME—special valve construction features require extra handling, extra machine time, extra man hours. Specify standard design controllers and conserve production time for the war effort.

CONSERVE CRITICAL MATERIALS — highest priority ratings supplemented by numerous directives require a large percentage of available critical materials — only enough left for use where absolutely essential to satisfactory valve performance.

HELP SPEED DELIVERIES — special construction means delay in the foundry; in obtaining materials; in the machine shop. Delivery of vital war material can be improved by your specifying standard construction.

Here at Fisher Governor Company every possible step has been taken to speed up the production of control equipment of standard design and construction. On most applications these "standards" will satisfactorily meet your operating conditions. Avoid special construction details that require extra machine time or critical materials unless your particular operating conditions demand it.

In a further move toward streamlining our production, certain types of Fisher Controllers, whose application overlapped other types of more standard design, have been discontinued for the duration. Should you order one of these discontinued items, we ask your co-operation in accepting the recommended substitute, remembering that FISHER GOVERNOR COMPANY GUARANTEES SATISFACTORY PERFORMANCE regardless of the substitution.

FISHER GOVERNOR COMPANY
425 FISHER BUILDING
MARSHALLTOWN, IOWA

MILLIONS OF FEET OF AIR *Cleaned* AND *Quieted* DOWN

Quick facts about AIR-MAZE oil bath Filter-Silencers

1. 99.83% continuous protection against dust and dirt.
2. Less than 1½" H_2O pressure drop.
3. Constantly cleaned by automatic oil-washing action.
4. Highly efficient acoustical chamber.
5. Made in a wide range of sizes and capacities.

AIR-MAZE Oil Bath Filter-Silencers

reduce excessive noise . . . eliminate abrasive grit

When a large Eastern company decided to install this huge compressor in the power plant of their foundry, they faced the two way problem of:

1. **Protection of compressor against unusual dust conditions.**
2. **Protection of workmen from objectionable intake noises.**

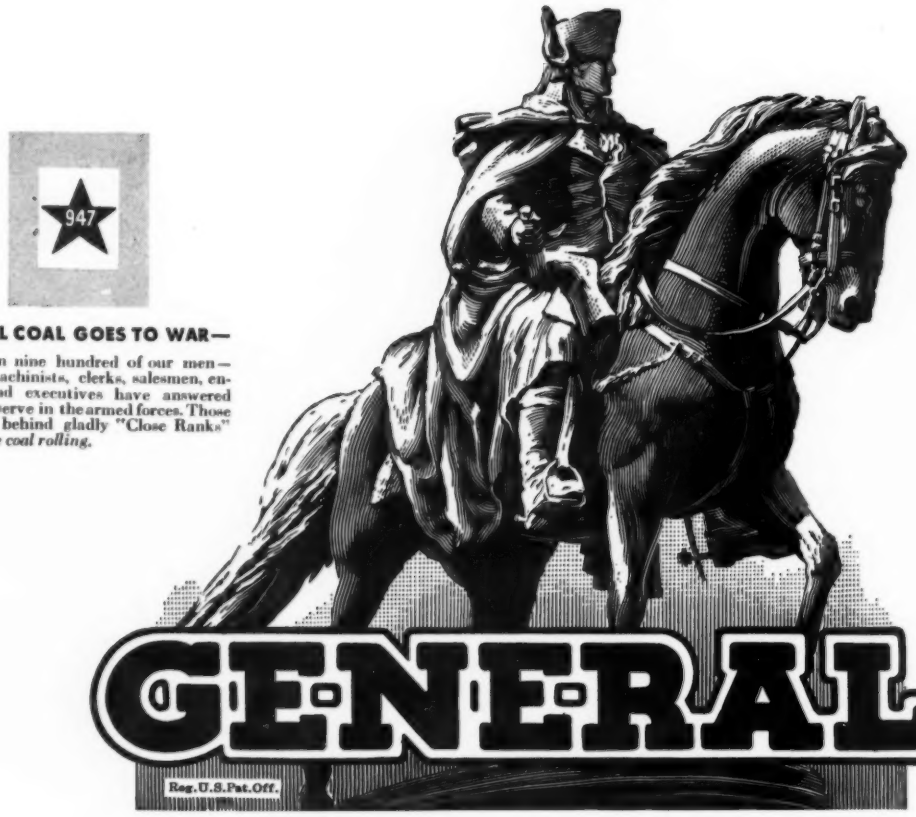
As shown above, Air-Maze Oil Bath type Filter-Silencers provided the satisfactory answer. Automatic oil-washing action now handles the heavy dust load. The highly efficient acoustical silencer unit reduces intake noise to a minimum.

Have you a problem that involves the cleaning and quieting of intake air? It pays to ask the AIR-MAZE engineers first.

AIR-MAZE CORPORATION • *General Offices, CLEVELAND, OHIO*

AIR-MAZE

DEPENDABLE AIR FILTERS FOR EVERY APPLICATION



947

GENERAL COAL GOES TO WAR—

More than nine hundred of our men—miners, machinists, clerks, salesmen, engineers and executives have answered the call to serve in the armed forces. Those of us left behind gladly "Close Rank" to *keep the coal rolling.*

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

GENERAL

Reg. U.S. Pat. Off.

RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE — Premium and standard qualities in the entire range of Anthracite burning characteristics.

Capable engineering personnel and the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

General Coal Company

123 SOUTH BROAD STREET — **PHILADELPHIA, PA.**

Branches

BLUEFIELD, W. VA.
BOSTON
BUFFALO
CHARLESTON
CHARLOTTE, N. C.
CINCINNATI
DETROIT
NEW YORK
NORFOLK
PITTSBURGH

BELTING AND HOSE WITH "THE THUMB"

Aristotle said: "The superiority of man over animals lies in the hand; the superiority over men, in the thumb."

For the movement of materials and transmission of power by belts and hose and the control of power by industrial brake lining, Thermoid Products have that extra something that is symbolized by the thumb.

Thermoid builds these products with an approach that is unusual. Thermoid engineers and production technicians have a realistic viewpoint. They visualize these products in use in the field rather than as just so much footage or poundage going through a plant. No wonder Thermoid Industrial Rubber Products have an outstanding performance record—they are born with the extra serviceability symbolized by the thumb.

When the order carries the name "Thermoid", every executive from the top to the bottom knows that the Purchasing Department is giving Production the best that can be had.

P.S. In line with material conservation, Thermoid has prepared a series of bulletins on how to extend the life of rubber products now in use. You might find them helpful as reminders to your operating people. Feel free to ask for copies.

THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products.

Thermoid Rubber

DIVISION OF THERMOID CO.
TRENTON, NEW JERSEY

IT'S GOOD BUSINESS TO DO BUSINESS WITH THERMOID

Foxboro Quick-Check Instrument Maintenance saves shut-downs, repairs, lost production

Now's the time to block off any chance of interruptions in the operation of your equipment. For, war times demand full-time production from every plant . . . without replacements or repairs requiring war materials or manpower.

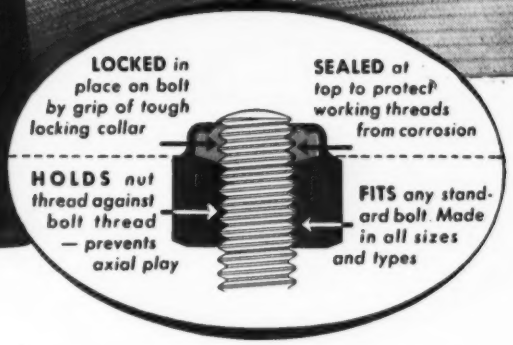
Here's an easy way to *make sure* of continuous top performance from your instruments. Send for free copies of Foxboro Quick-Check Maintenance Cards for each type of instrument you employ. These handy 8½ x 11" cards give A-B-C instructions for preventing damage to your instruments. So simple, even "green hands" can't go wrong. Equally useful for Foxboro or other standard instruments.

Take this easy step for wartime conservation. Write today for Foxboro Quick-Check Cards, specifying different types of instruments in your plant (recorders, controllers or indicators for temperature, pressure or flow). **The Foxboro Company, 68 Neponset Avenue, Foxboro, Mass., U. S. A.** Branches in principal cities of U. S. and Canada.

FOXBORO
REG. U. S. PAT. OFF.
Instruments

RECORDING • CONTROLLING • INDICATING

THESE ARE THE NUTS FOR TOUGH JOBS


LOCKED in place on bolt by grip of tough locking collar
SEALED at top to protect working threads from corrosion
HOLDS nut thread against bolt thread — prevents axial play
FITS any standard bolt. Made in all sizes and types

War jobs have posed infinite production problems.

We know a lot of them that were solved with as simple a thing as a nut.

Because the solution was an Elastic Stop Nut.

For example, aircraft. Their very worth depends upon fastenings that grip sure and won't shake loose under the chatter of machine guns, the impact of cannon fire and the vibration of air combat.

Every plane streaming off America's production lines has Elastic Stop Nuts fastening important structural parts. Several millions of them go into aircraft every day.

And to our knowledge, not one has ever failed to do its job.

With two big plants running full-tilt 24 hours a day, we can't satisfy all the needs of today's one big customer.

But in the days ahead, with Elastic Stop Nuts generally available, peacetime products and their production are going to be better.

And our engineers schooled in solving the rigorous problems of war production will be at the service of manufacturers with fastening requirements.

Whenever you wish, they will be ready to share their knowledge with you and recommend the desirable Elastic Stop Nut.

ELASTIC STOP NUTS

Lock fast to make things last

ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY

ESNA
TRADE MARK

YOU CAN BANK ON FAIRBANKS

for "SPHERO" BALL VALVES

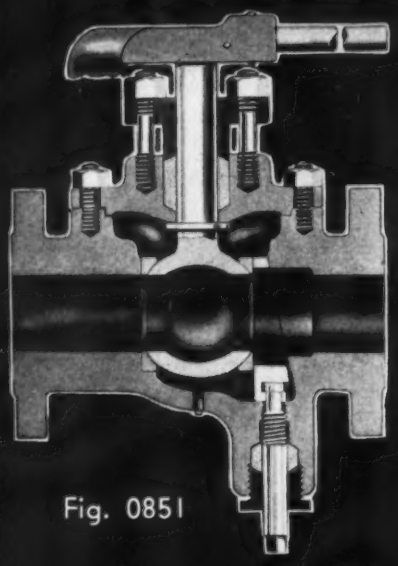


Fig. 0851

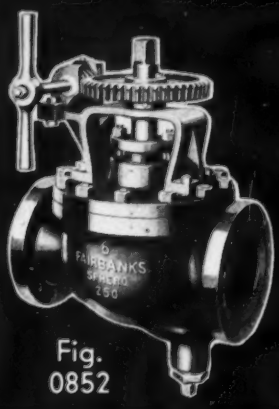


Fig. 0852

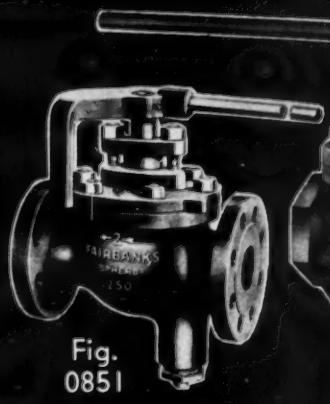


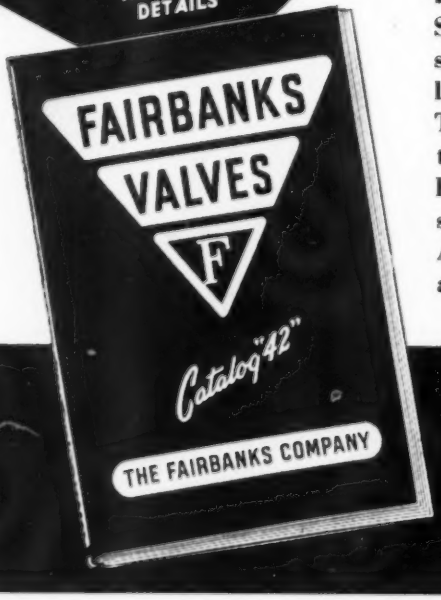
Fig. 0851

Fig. 0850

OTHER FAIRBANKS VALVES

Bronze Globe, Gate, Angle Cross and Check Valves
Iron Globe, Gate, Angle, Cross and Check Valves
Faircoseal Bronze Valves
U-Bolt Gate Valves
Asbestos Packed Cocks
Bronze Radiator Valves
Sphero Ball Valves

CONSULT FAIRBANKS NEW CATALOG No. 42 FOR DETAILS



For Blow-Off Purposes and Services Where A Full-Flow, Quick-Opening Valve is Desired

SERVICE: Recommended for service on steam, water, oil, gas and chemical lines. Available for pressure of 250 lbs.

TYPES: Fairbanks Sphero Valves are regularly furnished with a semi-steel or chrome nickel alloy body and bonnet, with bronze, iron, or cast-steel ball, operated by a lever or worm and gear. Can also be supplied in cast steel with stainless-steel ball and Ni-Resist steel rings.

FEATURES: Instead of the usual wedge or disc, Fairbanks Sphero Valves have a *revolving* Ball Plug which wipes seating surfaces clean. Its shearing action cuts through heavy solids and liquids. There is nothing on which foreign matter can accumulate. The opening in the Ball Plug is the same size as that in the pipe—there are no obstructions, no frictional resistance. Whether handling heavy viscous fluids or light gases, it has a leak-proof seal. Can be opened or closed with a quarter turn of handle. A positive stop tells when fully open or closed. There is an easy adjustment to take up wear.

THE FAIRBANKS COMPANY

393 LAFAYETTE ST., NEW YORK, N. Y.
BOSTON, MASS. PITTSBURGH, PA.

Distributors in Principal Cities

we pumped Niagara DRY!

A lot of water has gone over the falls but during the past 25 years Pacific Pumps all over the world have pumped millions of gallons of fluid—pumping equivalent to drying up many Niagaras.

But we aren't interested in drying up Niagara or in stopping the flow of any pumpable fluid! What we are interested in, and you should be, too, is the constant, steady, *continuous service* that Pacific Pumps are delivering twenty-four hours around the clock. When you install Pacific Pumps throughout your plant, you can be sure of commendation upon your choice, plus a long record of uninterrupted, trouble-free service that will attest to your good judgment many years from now.

For your present as well as continuing, long-distant-future pumping needs, put Pacific Pumps to work on your jobs.

A shipment to a single customer of Pacific type JH, 3-Stage and 4-Stage Pumps.

Pacific type JH, 5-Stage, Horizontal Split Shell, Boiler Feed Pump in use by Western Municipality.

PACIFIC PUMP WORKS
PACIFIC
HUNTINGTON PARK CALIF.

PACIFIC PUMP WORKS

Executive Offices and Plant: Huntington Park, California
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Affiliated Companies:
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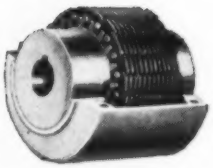
PACIFIC
Engineered
PUMPS

So It's Couplings You Need?

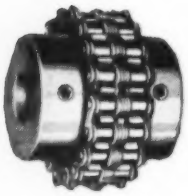
See MORSE

Wide variation of sizes and designs to fit every coupling application



Silent Chain Couplings

Easy to connect and disconnect, rugged and flexible, cushions shock loads and dampens vibration, machined finished faces for easy check-up and alignment. Enclosed in split, easily removable lubrication covers.



Roller Chain Couplings

All steel, two sprockets—one mounted on each shaft—wrapped by improved Morse Roller Chain. Easy to install and align, revolving cover available for smaller sizes, stationary cover for larger sizes. Special types, shearing pin, split hub and clamp hub can be supplied.

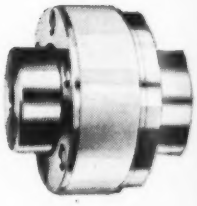
Morflex Couplings

Contain two steel hub members and a floating center unit assembly to which each hub is separately connected through resilient rubber trunnion blocks. There is no metal on metal movement. Rubber allows for maximum distortion without loss of efficiency. Cuts maintenance cost.

★

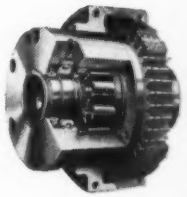
Morflex Radial Couplings

Sustain thrust and torsional loads. For heavy torque loads and for drives subject to shock or high frequency load reversals. Use specially shaped rubber trunnions. Entire unit machined all over to insure perfect balance.



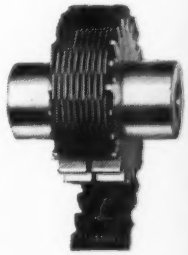
Free Wheeling Clutch Coupling

For coupling two shafts for high or low speed free wheeling. Morse Chain wrapped coupling integral part of clutch. Adapts the Morse full line of free wheeling clutches to tandem or endwise application.

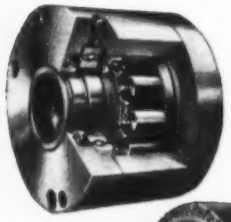


Silent Chain Accessory Coupling

Comprised of two flanges with special sprocket teeth wrapped with a silent chain. Provides a semi universal action and allows slight parallel misalignment without exerting overload on adjacent bearings. Chains easily removed for servicing.



MORSE CLUTCHES



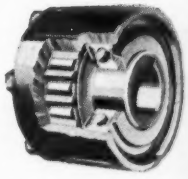
Free Wheeling Clutch

For wide diversified range of uses—indexing brake, back stop and dual drive service—wherever there is need for alternate or intermittent power between one or more prime movers coupled to driven members, positive locking action, high or low speed service.

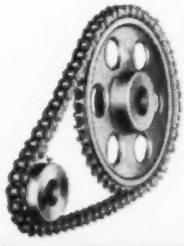
★

High Torque Indexing

Instant positive action of the spring-actuated cams of this inexpensive clutch makes it ideally suited to ratchet feed mechanisms where accuracy of indexing is essential. Insures closer indexing tolerance and increased number of strokes per minute.



Morse precision products also include silent and roller chain drives, sprockets, chain couplings, Morflex Couplings, Radial Couplings, Pullmore clutches, automotive timing chains and marine drives.



SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA, N. Y. DETROIT, MICH. DIVISION BORG-WARNER CORP.

A WORLD OF POWER!

As one of the few great names in Electric Power, it has been the province of Crocker-Wheeler to pioneer in the application of Electric Motors and Generators for many individual industries.

Today . . . as a part of the greater Joshua Hendy Iron Works . . . our enlarged productive facilities and specialized knowledge are more than ever available to all war industry.

Crocker-Wheeler Electric Manufacturing Company. Ampere N. J., Division of Joshua Hendy Iron Works.

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SWARMS of American-built bombers smash deep into enemy territory, night after night...while the miracle of U. S. production, rapidly transforming America into the world's mightiest air power, approaches this year's new goal of 10-thousand planes per month!

Behind our vast and growing strength in the air . . . underlying our matchless achievements on the assembly line at home . . . is *America's mastery of power,* basic tool of all modern industry.

In plane-plants . . . in factories of every type from coast to coast...wherever the job calls for round-the-clock production . . . Todd Combustion Equipment is contributing uninterrupted power...assuring efficient and trouble-free firing of liquid and gaseous fuels. Over 50-thousand Todd units are now in action throughout America.

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ARMY NAVY

Production for Victory... Buy U.S. War Bonds

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(Division of Todd Shipyards Corporation)

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NEW REEVES *Reducer-Type* TRANSMISSION

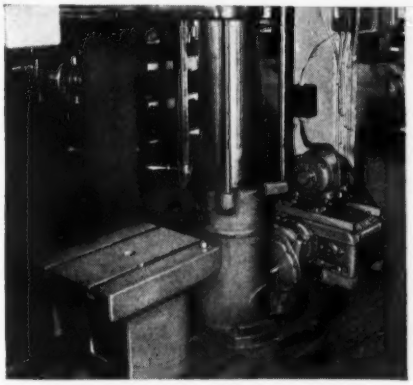
Combines Variable Speed Transmission and Gear Reducer in Single, Compact Unit . . .

● The REEVES Variable Speed Transmission, with built-in speed reducer, meets the many important requirements for accurate variable speed control and speed reduction combined in one compact, completely enclosed unit.

An outstanding advantage of this highly efficient drive is that far less mounting space is needed to obtain the lower output speeds which formerly required use of auxiliary speed reducing equipment.

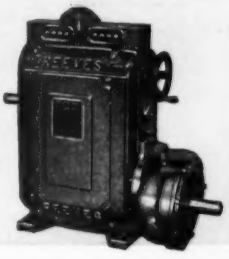
Available in two enclosed designs —horizontal and vertical—for mounting in any convenient position. Each design is available in wide range of speeds and in capacities from 1 to 7½ horsepower inclusive. The Transmission in various sizes provides ratios of speed variation from 2:1 through 12:1, and the reduction gears provide ratios up to and including 6.9:1.

Either horizontal or vertical design may be equipped for individual motor drive by use of a REEVES motor base. Motor mounting is directly above Transmission, the motor base being attached to top of Transmission frame. This base is universally adjustable to accommodate any standard make of motor of correct horsepower capacities for any given size of REEVES Reducer-Type Transmission. Send for copy of Catalog PTR-432, giving complete engineering information.



Horizontal design unit, with motor, direct connected to radial drill press.

Vertical design REEVES unit is especially adapted for conditions where floor space is limited.



REEVES PULLEY COMPANY • COLUMBUS, INDIANA

REEVES *Accurate Variable* Speed Control

This is the 1ST in a series of messages

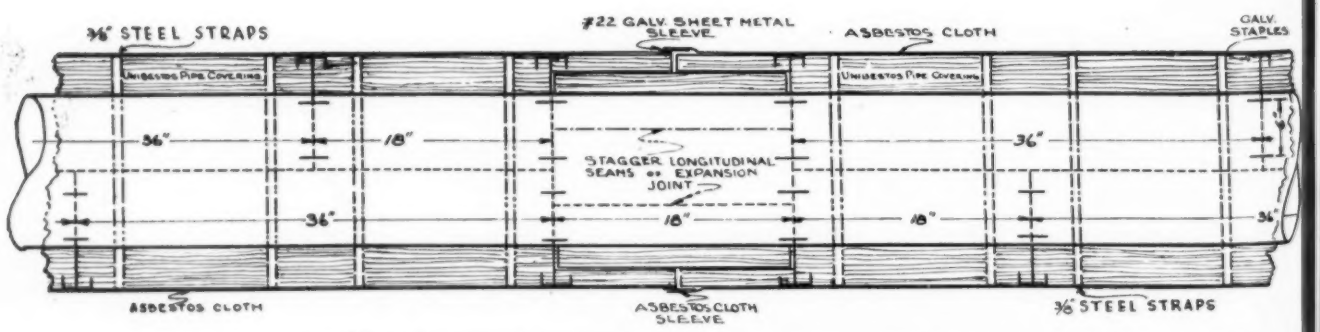
Dealing with the problems in heat insulation faced by power plant engineers and solved by using UNARCO unibestos

1a THE PROBLEM

In high-temperature work and particularly where large pipe sizes are involved the considerable pipe expansion that takes place presents quite a problem. It is a serious problem because there is a possibility of this expansion cracking the insulation at practically every joint, throughout the length of the pipe. This would result in a greatly lowered efficiency and ultimately would require the partial or complete reinsulation of the pipe.

1b THE SOLUTION

To compensate for this pipe expansion and guard against cracking of the insulation, application of Unibestos, the sectional insulation, is recommended in single-layer construction. Unibestos is strong and sections can be readily stapled one to the other on these large pipes, thereby definitely controlling the separation of the insulation. The separation is confined to one point which is easily covered by an expansion joint made from sectional Unibestos and applied as illustrated in the accompanying sketch.



unibestos is available in Standard material, for temperatures up to 750°; Super, with a temperature limit of 1200°; Combination, with a temperature limit of 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes. Unibestos is available in half sections up to 30" pipe diameter and from 32" to 60" in quadrants from ¾" to 5" in thickness. Standard and Super are available in single layer construction with provision for expansion in piping, where required.

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The recognized superiority of Aloyco Stainless Steel Valves and Fittings is due to concentration on this one type of product. Stainless Steel Valves and Fittings are not *part* of the Aloyco line — they are the *entire* line. They do not receive *part* of the attention of our engineering and production department — they receive *all* of it. We make a wide range of styles and sizes in all standard stainless steel analyses.

Although our facilities are allocated 100% to essential war production these days, we are always glad to discuss post war applications with those who are mapping the industrial pattern of the future.

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MORE POWER
...from your Veterans
HUNDREDS of America's veteran steam engines are again going into active service . . . answering America's call for more wartime power.
Whatever the operating temperature or pressure in your plant, you can be assured of maximum power output from your reciprocating steam engines, old or new, by lubricating them with *Texaco Steam Cylinder Oil.*
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So effective have Texaco Lubricants proved that they are definitely preferred in many other important fields, a few of which are listed in the panel.
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★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.
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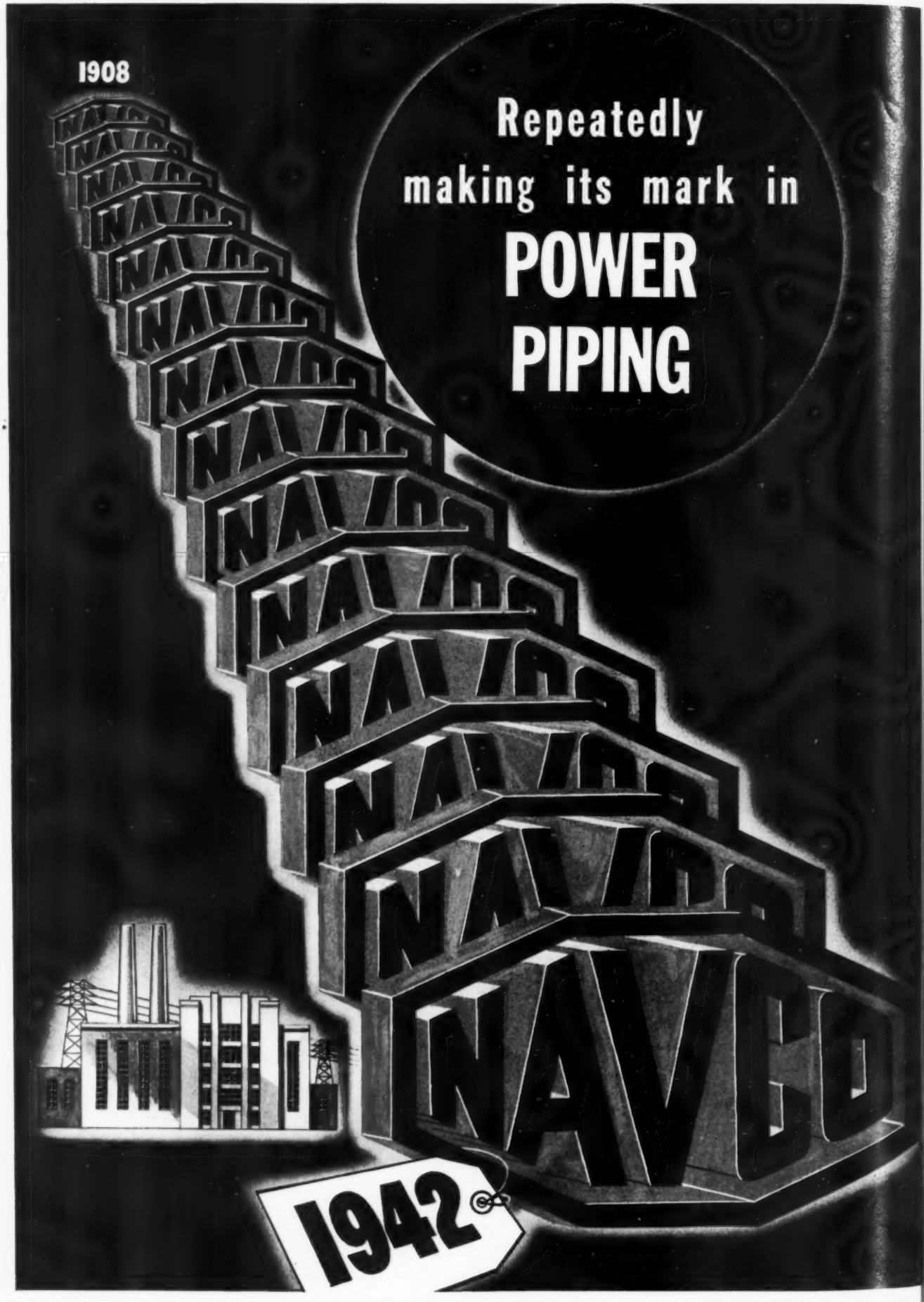
ELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



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Niagara Falls, N. Y.

Camp Rucker
Ozark, Ala.

Richmond Air Base
Richmond, West Va.

Chicago, Rock Island & Pacific Railway
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Alco Fabricating Corporation
Pawtucket, R. I.

Otis Elevator Co.
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Topeka Air Base
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U. S. Army, Chemical Warfare Service
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Automatic Machine Products Co.
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Republic Steel Corp. (Coal Plant)
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Base Engineering Bldg., Fort Jackson
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Electro Metallurgical Corp.
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Tennessee

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Collier Steel Corp.
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In addition, because only the finest workmanship and materials are used, CANTON STOKERS are guaranteed for FIVE YEARS . . . not only against defects but WEAR as well.

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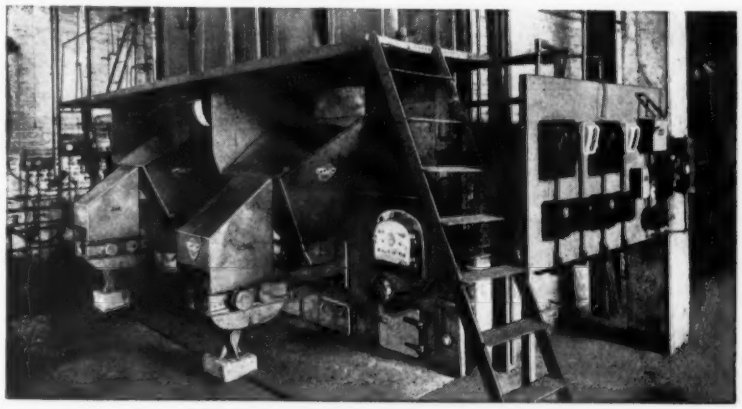


CANTON STOKER CORPORATION
ANDREW PLACE, S. W., CANTON, OHIO

Scovill Tube News

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No. 4

Common Causes of Corrosion In Condenser and Heat Exchanger Tubes

Types of Tube Corrosion

Film Formation

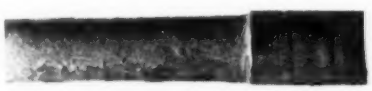
The corrosion resistance of condenser and heat exchanger tubing depends upon the nature of the films that form on the wall of the tube. The ability of copper and its alloys to form protective films on their surfaces under varying conditions of service explains their inherently excellent corrosion resistant properties. In some cases, this film may be formed simply as a result of oxidation. More often, however, the film is composed of an insoluble salt or a combination of insoluble compounds. In order to be protective, the film must be adherent, continuous and relatively insoluble. In general, thin films are more likely to have the more protective properties. It is evident that the formation of soluble salts at the metal surface will lead to continued corrosion. Likewise, coatings which are porous, loosely adherent, friable or easily broken, or discontinuous, offer little protection to the metal and may actually accelerate corrosion. Tubes which operate under service conditions which allow the formation of a uniform protective film will corrode only slowly and uniformly and will have a normal trouble-free service life. Under such conditions, tubes will last for periods in excess of 20 years. On the other hand, if operating conditions are not favorable to the formation of a protective coating, corrosion of one of the following types may be experienced.

Accelerated Uniform Corrosion

Tubes which are placed in service under conditions which result in corrosion at the tube surface with the formation of soluble salts only, will undergo a uniform thinning of the tube wall. The rate of such corrosion will depend upon the corroding medium, velocity of flow, temperature and other rate factors. Corrosion of this kind is often experienced in acid solutions, particularly with oxidizing acids or acid solutions containing oxygen or an oxidizing agent. Acid mine waters are very active in promoting corrosion of this type; also waters carrying a high carbon dioxide and oxygen content promote action of this kind. In addition to acids, solutions which have a definite solvent action on the products of corrosion of copper alloys, such as solutions containing ammonium hydroxide or cyanides, would behave similarly. Photographs of tube sections which illustrate various types of tube corrosion are shown on these pages. These photographs, reproduced in black and white from original four-color plates, bring out clearly the actual condition of the samples. The uniform thinning of the outside surface of a heat exchanger tube is illustrated in one of the photographs marked 1A and 1B.

"Service in Manuals" Designed for Scovill Customers Now Freely Available to All Wartime Tube Users

The "service in manuals" begun by Scovill years ago to assist customers in choice of alloys to fit specific corrosion and installation conditions, is now proving useful to many wartime firms faced with increasing need to conserve scarce tube metal. You may find in Scovill's "Condenser Tube Booklet" just the information you need — diagrams, formulae, lists of alloys — to make your condenser tubes serve you better and longer. A reprint of the article on this page, 4th in Scovill's continuing series of informative advertisements, is also available on request. Write Scovill Manufacturing Company, 13 Mill Street, Waterbury, Conn.



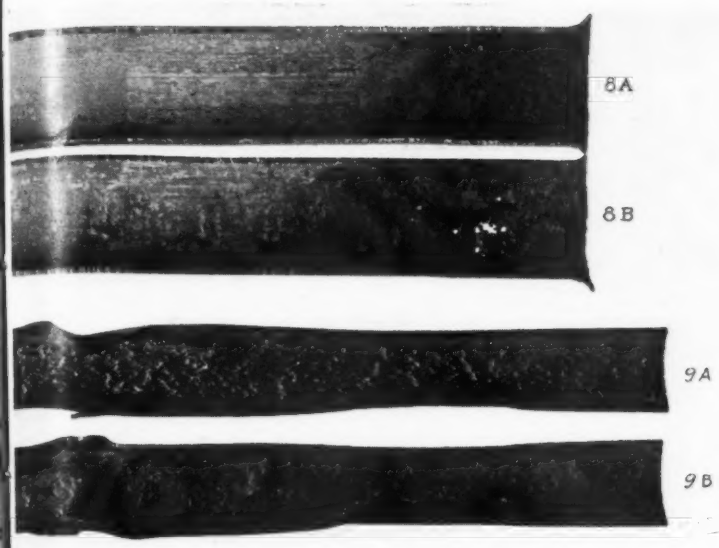
1A

1B

A comparison of the diameter of the tube end which was protected by the tube sheet (at the right of the section in 1A) and that of the tube beyond this section gives some indication of the marked uniform corrosion of the tube by the circulating medium. In 1B, a cross-sectioned view of the same tube shows the difference in tube wall thickness between the end within the tube sheet (approximately the original thickness of the tube) and the corroded section beyond the tube sheet. Corrosion of this tube was caused by condensate containing dissolved gases (Carbon Dioxide, Oxygen, Ammonia, etc.); it is to be noted that no appreciable corrosion product has accumulated at the outside tube surface.

Impingement Attack, End Corrosion, etc.

Tubes are sometimes placed in service under conditions which result in the rapid and repeated destruction of protective surface films. In most cases action of this kind occurs at or near the inlet end of the tubes and is variously described as "impingement attack, end corrosion, etc." There are usually certain localized areas in a unit or section of a unit where failures from this cause predominate. The destruction of protective films at such localized areas is due to a relatively high velocity of the circulating medium, together with a turbulent condition and the action of entrained or separated air. The attack is one of combined erosion-corrosion — erosion removing the scale or protective coating and subsequent corrosion of such exposed metal surfaces. Occasionally erosion-corrosion may extend along the whole tube length. Combined erosion

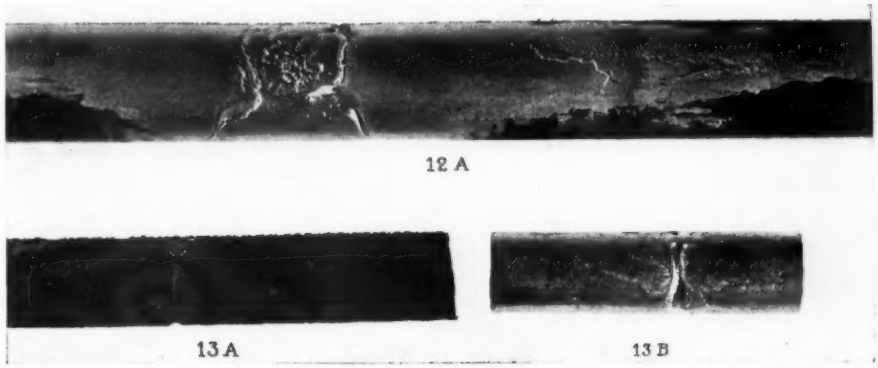


corrosion of tube surfaces may also occur when the circulating medium carries in suspension appreciable amounts of an abrasive material such as sand. An inlet piece of tubing which has been sectioned and opened up is shown in photographs 8A and 8B. Erosion-corrosion of the inlet end of this sample has been very severe as shown by a very roughened surface condition and tube wall perforation approximately 1" from the belled end of 8B. Beyond the first few inches from the inlet end, the tube shows no severe corrosion. The two sections of a tube in photographs 9A and 9B show an irregularly roughened inside surface over their whole length due to general erosion-corrosion of the metal.

Concentration Cell Action

Many cases of localized corrosion and failure of condenser and heat exchanger tubes are due to differential aeration or concentration cells which form at the metal surface under certain service conditions. A break in an otherwise satisfactory protective film may initiate such action. Porous coatings over the metal surface sometimes contribute to this type of corrosion. Cracks, crevices or other small openings at baffle or support plates where liquids may seep and become trapped are always a potential source of trouble in this respect. A similar type of corrosion may take place between strained and unstrained metal areas although corrosion from this cause is relatively rare. Concentration cell action is electro chemical in character and is due to potential differences between surface areas where a difference exists in the concentration of salts, ions or gases in the circulating medium. Two very good examples of concentration cell action are shown in photographs 12A and 13A and B. The outside surface of the tube section shown in 12A has a very badly corroded area which resulted in failure of the tube; corrosion and failure occurred at a baffle or support plate and was evidently due to concentration cell action between the area of the tube shielded by the baffle and adjacent areas. This tube was covered with a black scale over most of its surface, similar to that which is shown near the bottom at each end of the section, but this deposit was partially removed in order to show more clearly the corrosive action at the baffle area. The sections shown in 13A and B are parts of the same tube, 13A being an uncleaned piece just as it was originally removed from the unit and 13B a section with the scale removed. Both of these pieces have a deep circumferential groove at the outside surface, resulting from concentration cell action at baffle or support plates; corrosion in this case may have been due to a building up of iron rust or other corrosion product at the tube surface adjacent to the baffles or it may have been caused by seepage and trapping of liquid between the tube and baffles. "Water line" corrosion is a very excellent example of corrosion of the "concentration cell" type.

Additional types of corrosion will be discussed in the next issue of "Tube News".



Limitation order L-154 issued by the OPM. This order limits the use of non-ferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No non-ferrous metals containing more copper and more tin than these two are permitted by the order.

A 3-Way Service for Your Firm

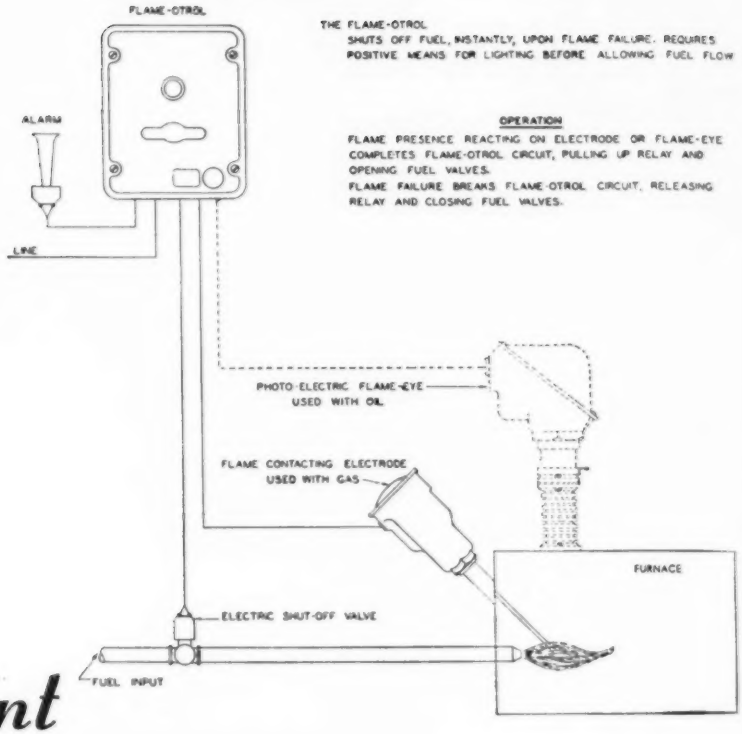
The services which Scovill offers to its customers, and to every wartime user of Condenser and Heat Exchanger tubes, are not limited to the "Service in Manuals" described above. Scovill's "Service in Men" places at your disposal the advice and consultation of men with years of experience in practical tube problems; while Scovill's "Service in Metals" offers you complete laboratory and production facilities, available as national needs permit.

Scovill
Manufacturers of Metal
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals ... Service in Metals ... Service in Men



THE FLAME-OTROL
SHUTS OFF FUEL, INSTANTLY, UPON FLAME FAILURE. REQUIRES POSITIVE MEANS FOR LIGHTING BEFORE ALLOWING FUEL FLOW

OPERATION

FLAME PRESENCE REACTING ON ELECTRODE OR FLAME-EYE COMPLETES FLAME-OTROL CIRCUIT, PULLING UP RELAY AND OPENING FUEL VALVES.
FLAME FAILURE BREAKS FLAME-OTROL CIRCUIT, RELEASING RELAY AND CLOSING FUEL VALVES.

You can prevent

COMBUSTION EXPLOSIONS

. . . regardless of fuel burned

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— provides instantaneous shut-off of fuel supply in case of flame failure. It is the only combustion safeguard approved by both the Underwriters' Laboratories and the Associated Factory Mutual Laboratories for all types of fuel. The FLAME-OTROL is available with automatic or manual ignition, time delay for purging, or any other sequence of operation desired.

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THE latest type electric weld tube mills are found at Electroweld Steel Corporation. The accuracy and dependability of this equipment coupled with the most modern testing facilities permit production of a product with three distinct benefits—safety, savings in weight, and savings in cost.

This equipment forms tubing from strip steel which is rolled accurately to gauge. Thus the wall thickness is uniform, and lighter gauge material may be used without sacrificing strength. As a result, there are no thin spots in the wall of Electroweld Tubing, and you save weight. The strip steel meets your specifications accurately, and after it is formed into tubing the strength at the weld and adjacent areas will equal that of the strip steel. Every foot of Electroweld Tubing is hydrostatically tested for safety. Therefore, it not only meets your specifications but also Government requirements.

Electroweld Tubing may be adapted economically to boiler, heat exchanger, and condenser installations as well as to mechanical applications since it may be cut, formed, and welded more easily. During the post-war period, you will find it worth-while to consider Electroweld Steel Corporation YOUR source of supply.

Uniform diameter
Uniform wall thickness
Uniform physical properties
Test proven welds
Scale-free, silver-bright finish
Square cuts, minimum burr

Electroweld

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Manufacturers of pressure and mechanical steel tubing

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PRE-FABRICATED PIPING

The "battle of production" requires manpower in enormous volume. But it needs more than volume . . . more than mass . . . it needs *skilled* manpower. Already there is a shortage in many places. The supply of skill is limited. We must bend every effort to make the best possible use of skilled labor.

You can help win the "battle of production" by specifying Pre-Fabricated Piping rather than by trying to build your own crew for field fabrication.

Workmen employed by qualified pipe fabricators work in plants equipped with modern machinery and every other useful labor saving device. They follow carefully prepared routines and procedure controls which (together with the equipment) enable them to produce better work . . . faster . . . and with the utilization of fewer man hours.

Pre-Fabricated Piping comes to you in a series of sub-assemblies with all difficult welding done. These sub-assemblies are commercially practical, heat treated and stress relieved when necessary, shop tested, accurately aligned, thoroughly cleaned and inspected. Erection requires a minimum of time and labor.

E-11

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"MEGGER"*

THE *NEW* "MEGGER" INSULATION TESTER···

The first U.S.-made "Megger" Instruments for testing electrical insulation resistance are now being built in our Philadelphia factory and we expect to be in full production by about June 1st of this year.

These new "Megger" testers are of the same hand generator and direct reading ohmmeter type, and the same high quality, as our time-tested "Meg" and "Super-Meg" instruments, which are so well-known for their great ruggedness and durability. They are housed in molded cases of high impact-strength plastic material.

Our manufacturing facilities are complete, and we now offer these new U.S.-made "Megger" testers for delivery as soon as your priority and our expanding production will permit. We invite your orders for them. *Write for new Bulletin Number 1735-P.*

By special arrangement with the original makers of the "Megger" Testing Sets, our new instrument carries the U. S. registered trade mark name "MEGGER."

JAMES G. BIDDLE CO. · 1211-13 ARCH STREET · PHILADELPHIA, PENNA.

Emergency Power

on full load *Automatically* in 15 seconds with

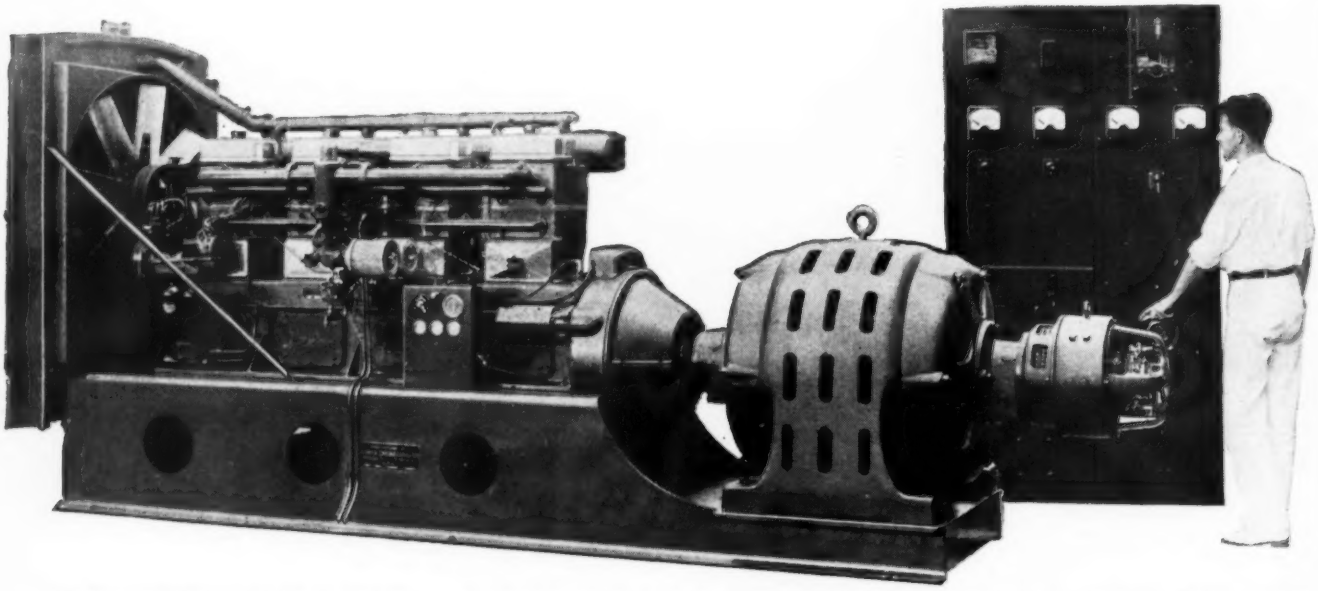
Climax Generating Sets

NOW is the time to make doubly sure that your emergency power equipment is adequate and in sound condition. With the ever-expanding power demands of war production, overloading and breakdown of generators is becoming more and more frequent.

You can prevent dangerous overloading, prolong the life of your normal power equipment, and level off peak loads with Climax Generating Sets. A well integrated line of these units is available in capacities up to 312 KVA. Parallel operation of multiple units permits running at most economical load factor, and generates a sufficient capacity to handle peak loads at minimum cost.

Find out how these sets can be planned to meet your industrial needs. Complete information will be furnished by writing to Department X, Climax Engineering Company, Clinton, Iowa.

This set at the Federal Jail, Terminal Island, Calif., consists of a Model R81, 220-hp., 8-cylinder Climax "Blue Streak" Engine direct connected to a 125 KVA Fairbanks Morse 1200 r.p.m., 60 cycle, single phase 125-250 volt generator. The Climax-built switchboard starts the set automatically within 15 seconds of normal power failure.



...Climax Generating Sets are used for both Standby and Normal Power Supply

For Standby Power . . .

1. To lengthen the life of other types of generating equipment by preventing overloading during peak periods.
2. To make possible higher loading without a comparable increase in equipment costs.
3. To provide dependable low-cost protection for valuable equipment which must be continuously operated.
4. To effect savings in power bills, for industrial plants, by reducing consumption of purchased power during peak demand periods.
5. To produce electric power at low cost through use of local fuels, particularly where natural gas is available.

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1. Climax Generating Sets are "tailored" to individual requirements and absorb overloads without speed reduction. Thus making possible uniform output voltages.
2. To meet load variations economically through synchronized and parallel operation of generating sets.
3. To provide unfailing operation through the ability to burn different fuels—natural gas, sewage gas, butane, gasoline, etc. Should one supply fail, another fuel can be used.
4. To generate electricity at low cost through the use of local fuels.

Climax
Engineering Company
GENERAL OFFICES & FACTORY:
CLINTON, IOWA
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THE VALVE THAT REALLY SAVES CRITICAL MATERIALS

Saves water

•

Amazing endurance to both use and abuse

•

Fewer parts

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Corrosion resistant

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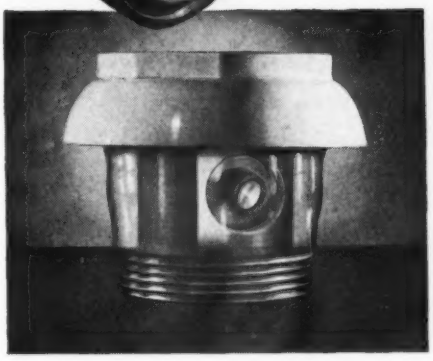
Shipping weight reduced 2½ lbs.

The War Department Specification (PE-623) permits the use of 2¼ lbs. of copper-base alloy, and the Sloan Valve Company has complied with this specification since its inception in June, 1942. However—fully realizing the need for critical copper in the war program, Sloan engineers greatly bettered this limit. ***The new Victory valve uses less than four ounces of copper***—which, based on present production, means an annual saving of 4,406,000 lbs.

This amazing reduction in critical materials was brought about through the substitution of plastics and malleable iron. Furthermore, the use of these substitute materials has appreciably reduced the number of parts, and the new valve is 2½ lbs. lighter in shipping weight. All parts have been thoroughly field tested, and the complete valve has undergone laboratory accelerated-time tests equal to 10 years normal service, after which the Victory valve was still working perfectly and without need for repair.

While the new Victory Vacuum Breaker is all-plastic, no change was made in the functional design of the original Sloan V-100-A, which was the first vacuum breaker to be approved by the N.A.M.P. Testing Laboratory at the University of Iowa. Its outer-shell, now of transparent plastic, permits *visual* inspection, thus assuring the ultimate in protection against back-syphonage.

SLOAN VALVE COMPANY
4300 West Lake Street
CHICAGO

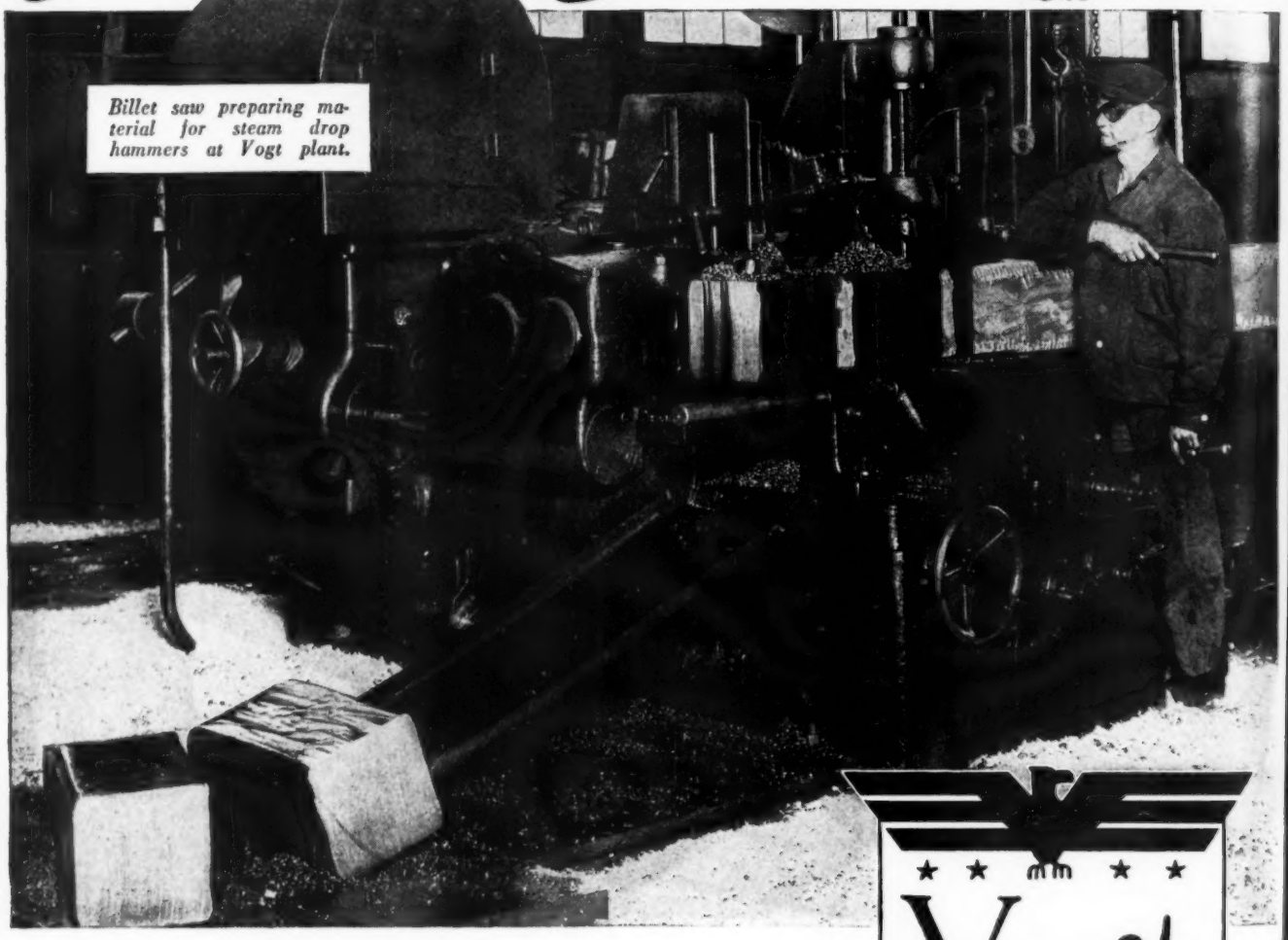


The new Victory Vacuum Breaker is all-plastic; its transparent outer-shell affording *visual* inspection. Instantaneous in action, it prevents back-syphonage and so protects health.

SLOAN *VICTORY TYPE* FLUSH VALVES

"SAWING WOOD AND SAYING NOTHING". . . . *an old American saying*

~~Sawing Wood~~ Steel



Billet saw preparing material for steam drop hammers at Vogt plant.

and keeping WAR PRODUCTION MOVING FASTER FOR VICTORY

We're attending strictly to business here at Vogt's and quickening the tempo of War Production without fuss or feathers. Vogt Products for Power Plants, Chemical Plants, Oil Refineries, Ship Yards, Powder Plants, Synthetic Rubber Plants, etc., are being delivered in ever increasing volume to meet the requirements of the War Program FOR VICTORY!

★ ★ ★ ★ ★

Vogt

PRODUCTS HAVE GONE TO WAR

★

DROP FORGED STEEL VALVES FITTINGS AND FLANGES

★

OIL REFINERY AND CHEMICAL PLANT EQUIPMENT

★

WATER TUBE BOILERS

★

ICE MAKING AND REFRIGERATING MACHINERY

★

HEAT EXCHANGERS

BUY WAR BONDS AND GET IN THE SCRAP

HENRY VOGT MACHINE CO.
LOUISVILLE, KY.
Branch Offices: NEW YORK PHILADELPHIA CLEVELAND CHICAGO DALLAS

RECOGNIZED
Experience
New Airplane Engine Plant in the Middle West
Designed by Albert Kahn, Associated Architects and Engineers, Inc., Detroit.

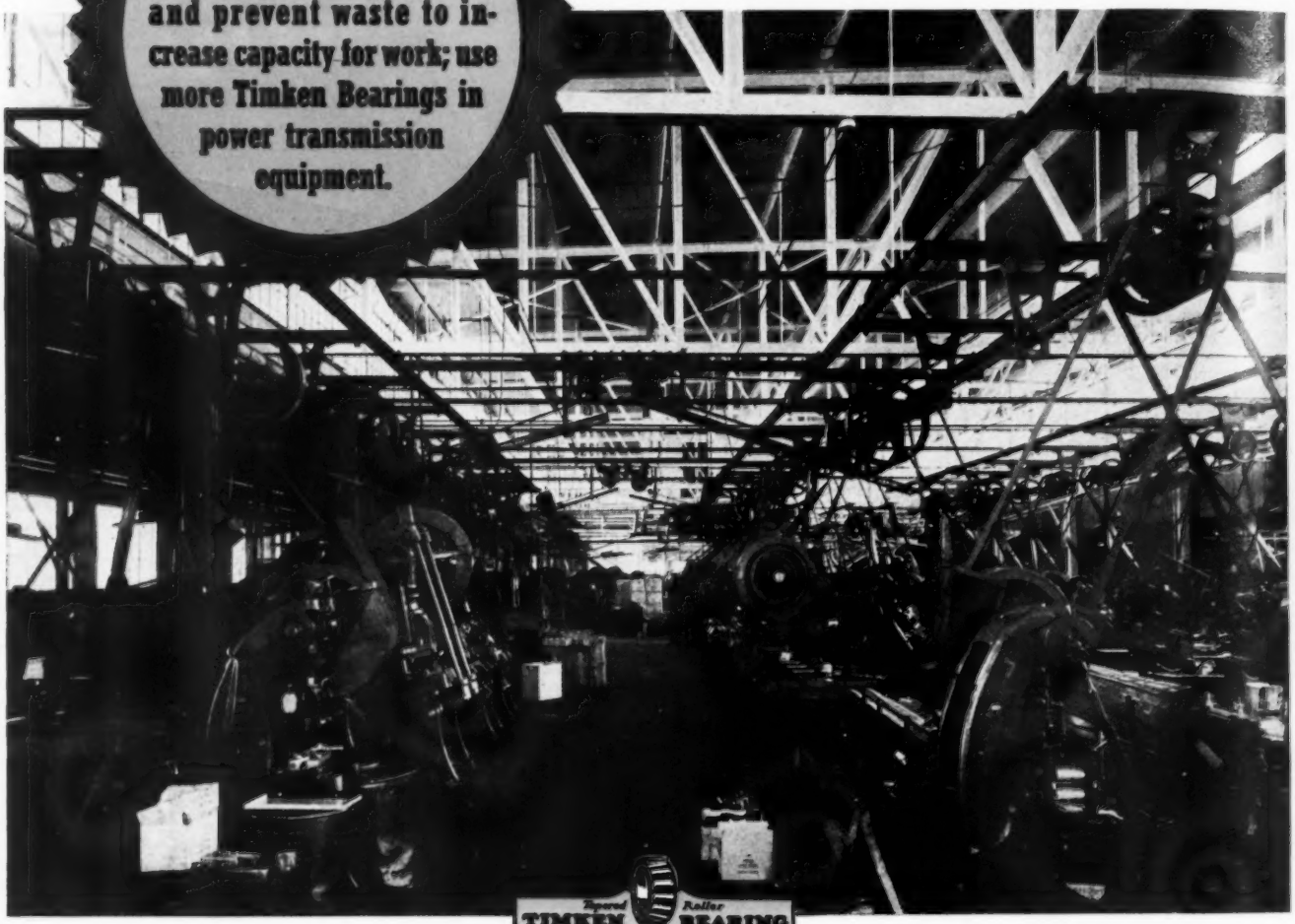
ONCE MORE, Minneapolis-Honeywell helps those who help! In this new airplane engine plant in the middle west, M-H Controls govern conditions to help speed production. • No matter what control requirements may be—whether for a sleek, new modern building like this outstanding plant designed by Albert Kahn—or for an older plant being converted to war production—Minneapolis-Honeywell has the experience, the knowledge and the facilities to produce exactly the results desired—at minimum expense. Minneapolis-Honeywell Regulator Company, 2707 Fourth Avenue South, Minneapolis, Minnesota. Company owned branches in 49 principal cities.

MINNEAPOLIS-HONEYWELL

Regulator Company

Keep power flowing smoothly, constantly for Victory and prevent waste to increase capacity for work; use more Timken Bearings in power transmission equipment.

Dodge-Timken Line Shaft Hangers supporting group drives in a large plant manufacturing electrical equipment.



Production depends on power and never was power so precious as now. Preventable power loss is bad enough when it hurts no one but the loser; it is intolerable now that the safety of the nation is at stake.

Obsolete power transmission equipment is responsible for more wasted power than anything else. Furthermore, it is a frequent source of wasted production time as well, through involuntary shutdowns caused by transmission failure.

Is your production threatened by friction-ridden, power-preying line shaft hangers and pillow blocks that should have been thrown out long ago? Check up without further delay and replace every one you find with a modern Timken Bearing Equipped unit.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
TAPERED ROLLER BEARINGS

"All There Is In Bearings"

The one test for every decision — **Will It Help To Win The War?**

PEDRICK PRECISION answers the prayer

WHEN 371 M.P.H. PRAYS FOR 381

• Overtaking Zeros, outrunning U-boats, out-maneuvering Mark VI tanks—those toughest of combat jobs are Pedrick's most dramatic contributions to victory. But the Pedrick *precisioneered* piston rings that are generating extra kilowatts, plowing extra acres, and delivering extra highway miles are doing just as big a job to win this mechanized and total war.

This Pedrick accuracy of tension and dimension is now delivering extra power on a dozen battle-fronts. This Pedrick design-for-the-conditions is now saving fuel and oil and service-hours on ten thousand production-fronts at home.

Pedrick precision and engineering experience, Pedrick "heat-shaping," Pedrick operating economies and long life have long since earned the respect and confidence of the manufacturers, operators, and maintenance-men of American business. WILKENING MANUFACTURING CO., Philadelphia. *In Canada:* Wilkening Manufacturing Co. (Canada), Ltd., Toronto.

TO POWER-PLANT ENGINEERS

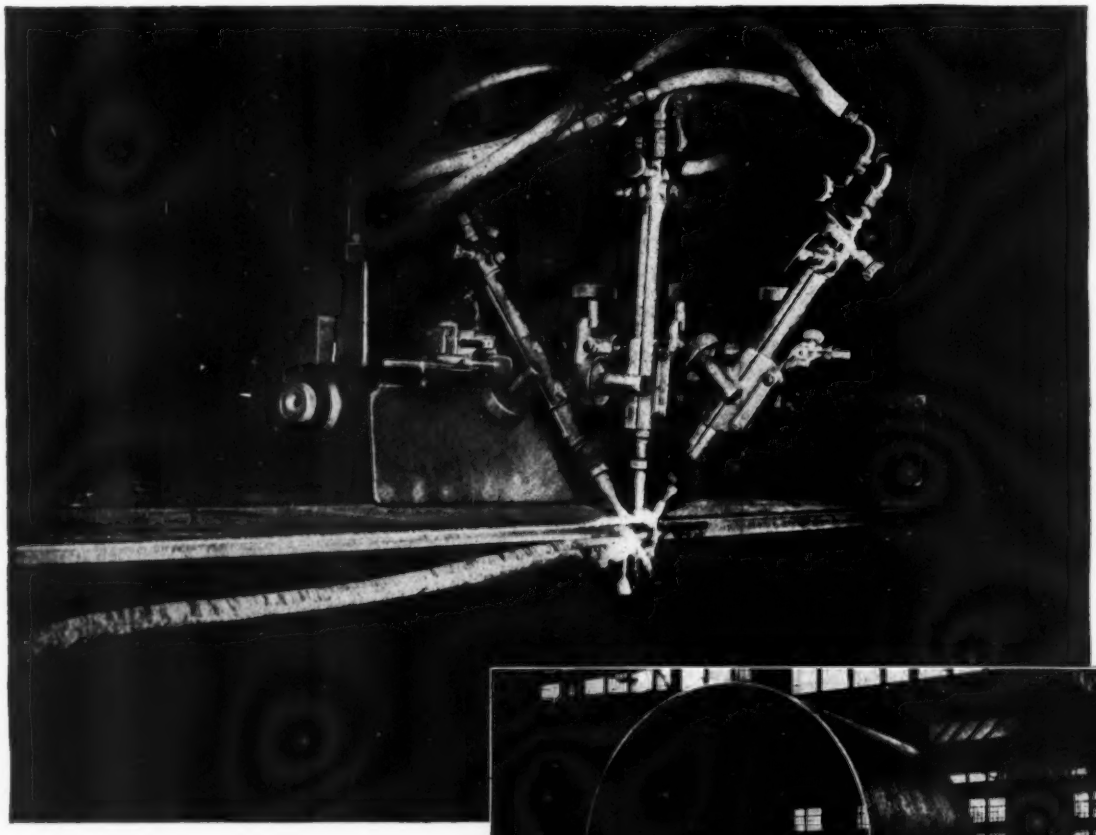
Your internal combustion engines, as in every essential industry, are handling peak loads on a non-stop war-time schedule. Inefficiency or frequent overhauls literally can lose battles. These are days when you will appreciate most the efficiency, dependability, and long life of Pedrick *precisioneered* piston rings—backed by more than a quarter-century of specialized experience.

Pedrick

HEAT-SHAPED PISTON RINGS

ALCO

ENGINEERS AND MANUFACTURERS



Modern methods speed up preparation of plates and permit uninterrupted use of plate rolls.

The use of automatic equipment in the preparation of steel plates for the rolling and welding into heat exchanger and pressure vessel shells helps the war effort.

AMERICAN LOCOMOTIVE COMPANY

ALCO PRODUCTS DIVISION

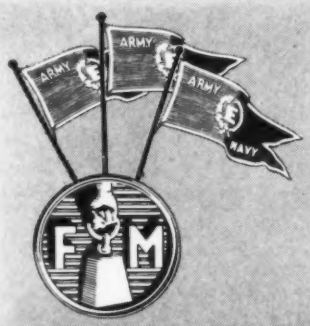
30 CHURCH ST., NEW YORK, N. Y. **DUNKIRK, N. Y.**

-you wouldn't accept a 10% increase in power cost without a protest

FAIRBANKS-MORSE TURBINE PUMPS
The F-M line offers complete range of capacities from 35 g.p.m. to 4000 g.p.m., for electric motor, Diesel or gasoline engine, or steam turbine drive. Open or closed impellers. Oil or water lubrication.

A SUDDEN boost of 10 per cent in power rates? You'd call it ridiculous—but many ten-year-old pumps of certain types, *even if as good as new,* take 10 per cent greater toll at the meter than today's Fairbanks-Morse models! And a 10 per cent reduction in power consumption is anything but ridiculous—especially now.

Before you arrange for increased power to meet heavier production schedules, eliminate power waste. Your resident Fairbanks-Morse Engineer can tell you quickly—without cost or obligation—whether or not the pumps you have are the types that exact the penalty of obsolescence. You may discover, as others have, that new pumps would solve your power problem today—and your cost problem tomorrow. Use your priority to buy for today with an eye on tomorrow's cost sheets. Write Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago, Illinois.



FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
SCALES
WATER SYSTEMS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS
RAILROAD EQUIPMENT

Pumps

TAKE CARE OF YOUR DIESEL

★ ★ ★ Many parts of your Diesel are manufactured of critical materials—materials that are most difficult to obtain even with the highest of priorities. Therefore now, as never before, the full efficiency of your Diesel should be maintained by proper care and attention. Lessened power, lost time and wasted money are the least of the inevitable results of laxness in engine maintenance.

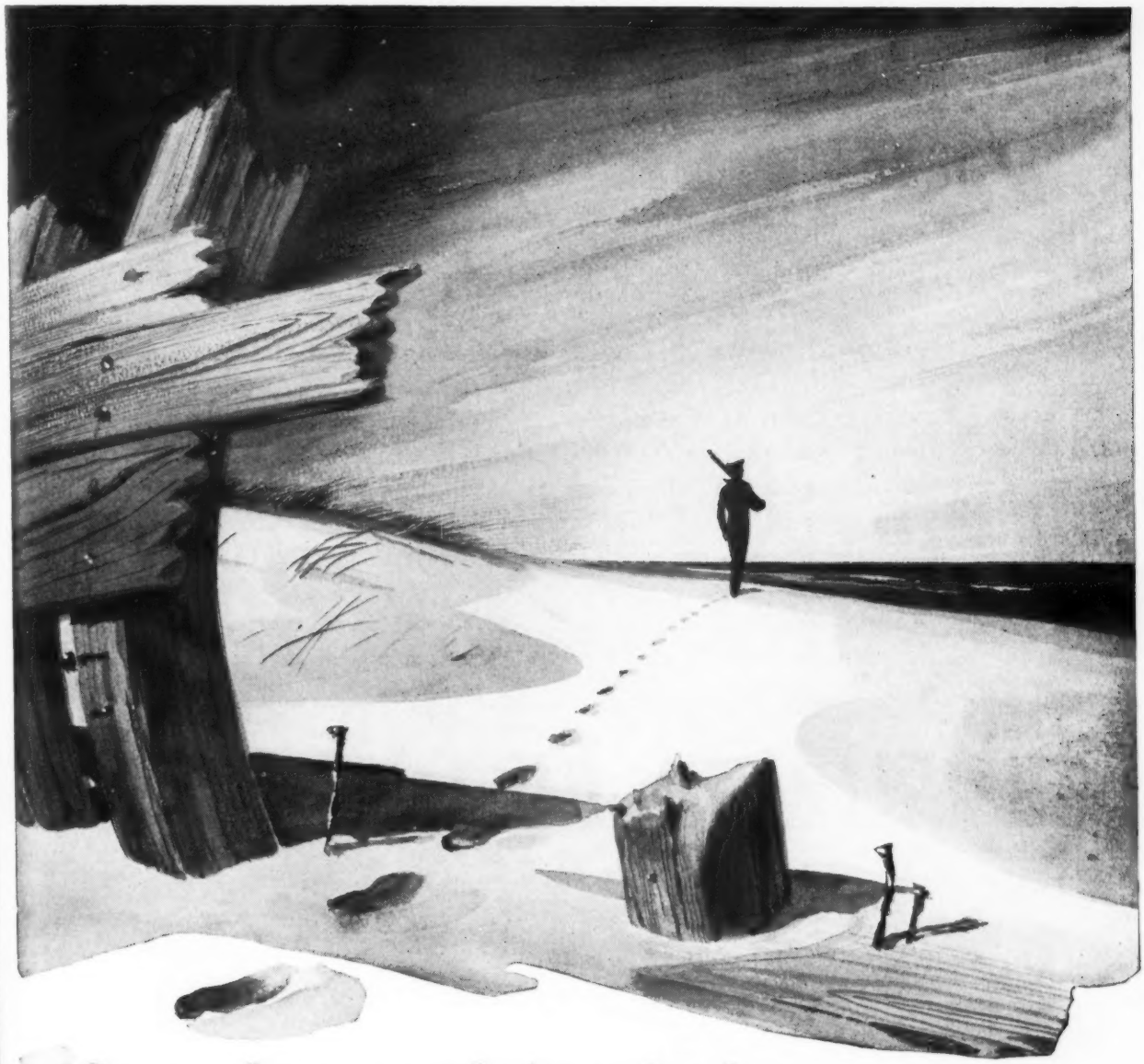
Superior Diesels, sturdy and rugged as they are, nevertheless require regular attention—just as any other precision machinery. In order that you may obtain the full measure of service they were designed to deliver, and at the same time help us to conserve the vital materials necessary to replace parts needlessly broken or worn out, we ask that you:

1. Avoid continuous overloads.
2. Use only clean fuel and high quality lubricants.
3. Keep all filters clean.
4. Replace worn or stuck piston rings at once.
5. Grind valves and check clearances regularly.
6. Maintain proper clearances of main and connecting rod bearings.

SUPERIOR ENGINE DIVISION

THE NATIONAL SUPPLY COMPANY

SALES OFFICES: Springfield, Ohio; Philadelphia, Penna.; New York, N. Y.; Los Angeles, Calif.; Chicago, Ill.; Jacksonville, Fla.; Houston, Texas; Fort Worth, Texas; Tulsa, Okla.; Boston, Mass.
FACTORY: Springfield, Ohio



Steps that guard America!

He walks alone. His footsteps, plodding down some unnamed, silent beach, are a trail of protection between you and our Axis enemies.

Within the nation itself, there's a guardian's job we all can share. By caring for our tools and equipment, we make them last longer . . . and so save vital metals, and time, for greater war production. Storage batteries, for instance, last longer when you follow four simple rules of conservation. Obey them and you hit the Axis. Buy to Last and Save to Win!

Exide
BATTERIES
FOR CRANKING
DIESEL ENGINES

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
Exide Batteries of Canada, Limited, Toronto

STEPS THAT GUARD BATTERIES!

1. Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.
2. Keep the top of the battery and battery container clean and dry at all times. This will assure maximum protection of the inner parts.
3. Keep the battery fully charged—but avoid excessive over-charge. A storage battery will last longer when charged at its proper voltage.
4. Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

If you wish more detailed information, or have a special battery problem, don't hesitate to write to Exide. We want you to get the long-life built into every Exide Battery. Ask for booklet Form 2399.

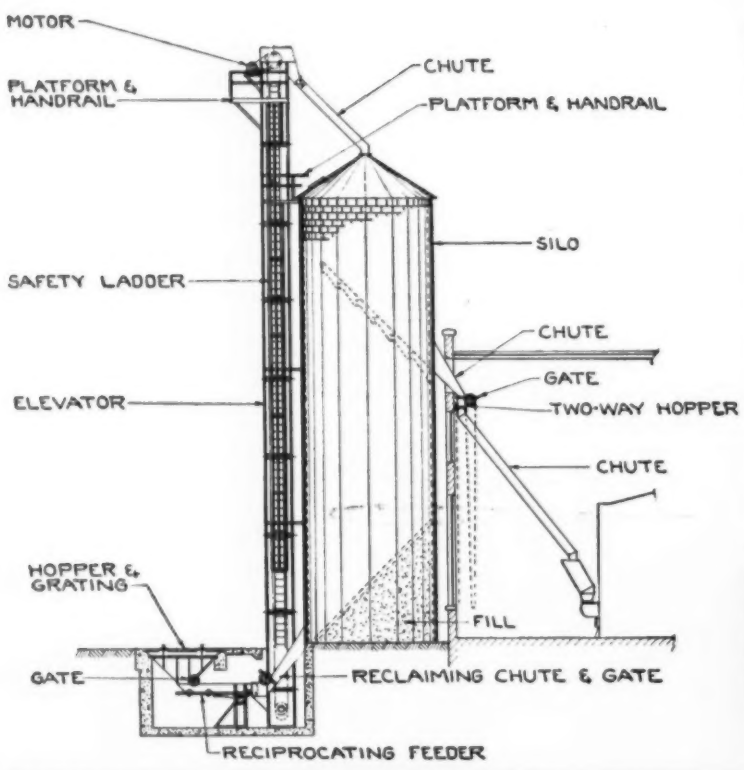
FUEL OIL HAS GONE TO WAR

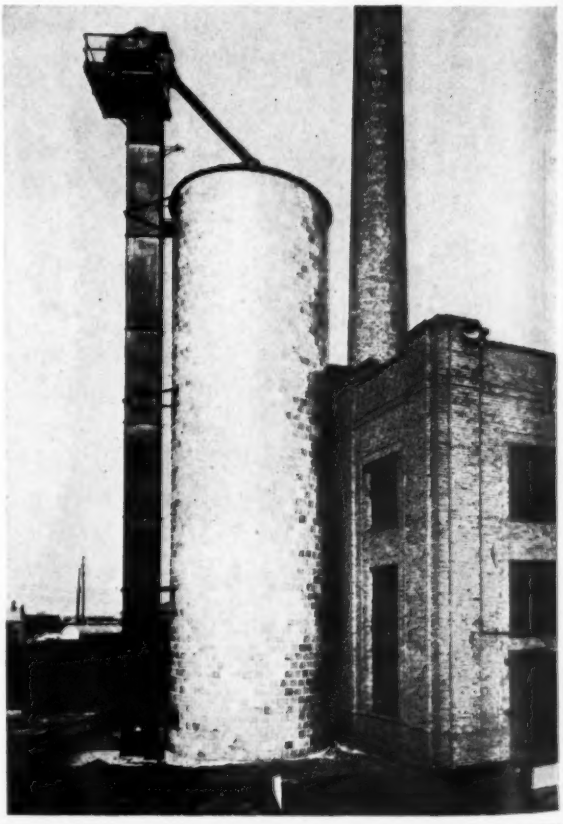
• CONVERSION . . . *is the Order*
• CONSERVATION . . . *the Objective*
• Do It The Modern Way With

● And Fairfield is really playing a signal part in this nation-wide program.

Hundreds of Fairfield Silos have been installed where plant operators "just didn't have storage possibilities." These silos, 12 to 24 ft. diameter, are built of vitrified tile (non critical material) in capacities up to 1000 tons storage. They do not absorb moisture, and the wall construction is an effective insulation against freezing. A Fairfield Conveyor or Weigh Larry handles the coal from Silo to boiler. The whole installation is amazingly simple and surprisingly economical. A new catalog (No. 140) tells the story in pictures and drawings. Don't you want to get acquainted with *this* modern way—

THE FAIRFIELD SILO SYSTEM

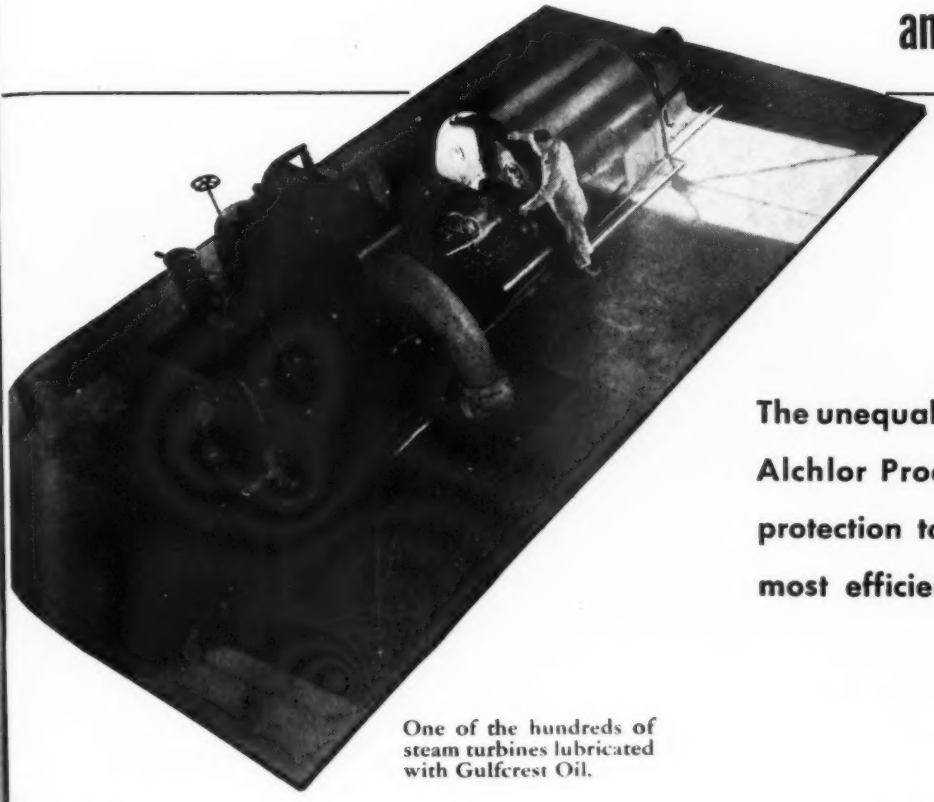




THE FAIRFIELD ENGINEERING CO.,—MARION, OHIO

GULFCREST OIL

stands alone in its high resistance to oxidation, acidity, and sludge



One of the hundreds of steam turbines lubricated with Gulfcrest Oil.

The unequaled refining power of the Alchlor Process insures maximum protection to turbine bearings and most efficient turbine performance

THE stability and endurance of a turbine oil—and the degree of protection it provides—are directly related to the amount of impurities which remain in it after refining. That is why the development of Gulf's Alchlor *Super-Refining* Process has proved such an outstanding contribution to turbine lubrication.

For the Alchlor Process is the most effective oil purifying method known—it not only removes the general run of impurities present in all crude oils, but eliminates oxidation catalysts and synthesizes and rearranges the molecular structure of certain active hydrocarbons. This unequaled refining power of the Alchlor Process produces a turbine oil with highest resistance to oxidation, acidity and sludge—an oil that insures maximum protection to precision turbine bearings and most efficient turbine performance. Gulfcrest Oil is the world's finest oil for turbine lubrication!

Talk with a Gulf Lubrication Service Engineer about this remarkable turbine oil at your earliest opportunity. He will be pleased to give you complete details, without obligation.

GULF INDUSTRIAL LUBRICATION

For Victory Buy United States War Bonds and Stamps

GULF OIL CORPORATION · GULF REFINING COMPANY · PITTSBURGH, PA.

For Safe, Accurate Pressure Control

GOLDEN-ANDERSON

STEAM PRESSURE REDUCING VALVES

Wherever it is imperative that low-delivery pressure be maintained—wherever there is a "dead end" or no service consumption that downstream pressure will not build up, G-A Steam Pressure Reducing Valves are the logical choice.

This valve has been specifically designed to hold the adjusted delivery pressure at all times under any necessary flow capacities—furnished double extra heavy throughout yet they are ultra-sensitive in operation and capable of meeting any minimum or maximum flow capacities.

The G-A Steam Pressure Reducing Valves are the heaviest of their kind, with the result that there is no distortion or warping under pipe line stress or strain.

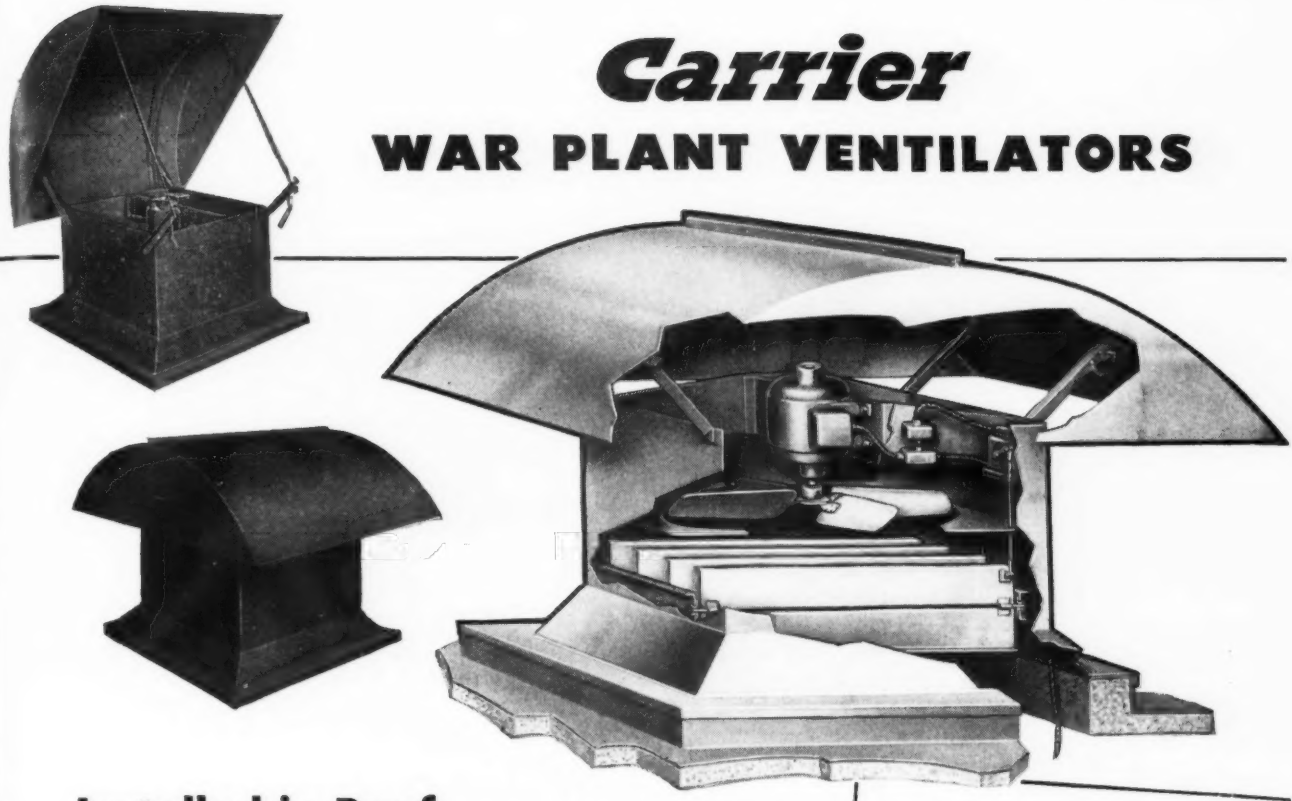
★

also The G-A line includes Altitude Valves to prevent overflow of Standpipes, tanks, etc. —Emergency Stop Valves to prevent runaway turbines or engines — Steam and Water Pressure Reducing Valves, Check Valves, Float Valves, etc. Our new, illustrated catalog describes the full G-A line—write for it today.

GOLDEN-ANDERSON
VALVE SPECIALTY CO.
FULTON BLDG. • PITTSBURGH, PA.

Carrier

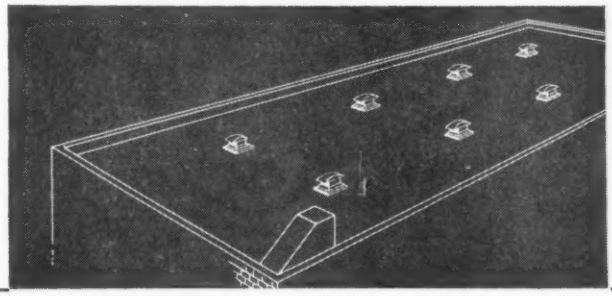
WAR PLANT VENTILATORS



Installed in Roof . . .
No Floor Space Needed!

War plant workers need air free from excessive heat or humidity to maintain maximum production. In warm weather, extra quantities of outdoor air must be provided for ventilation to prevent indoor temperatures from soaring. In winter weather, the air for ventilation must be tempered to prevent drafts and cold areas.

Carrier War Plant Ventilators replace hot, humid air in summer—temper ventilating air in winter. They are available in 3 types to provide blackout and other factory buildings with uniformly distributed air for correct ventilation.



1. **Carrier Exhaust Ventilators** (shown above) remove hot, humid air from the plant, exhausting it at the roof.

2. **Carrier Supply Ventilators** replace the excessively hot plant air with relatively cool air from outdoors, drawing the air in at the roof and supplying it with uniform circulation to working areas.

3. **Carrier Tempering Ventilators** warm and deliver air to the plant, drawing the air in at the roof and supplying it with uniform circulation to the working areas, thereby providing the needed ventilation with tempered air to prevent drafts and cold spots in the plant during cold weather.

Features: Critical materials conserved by use of non-ferrous panels. No extra "preparedness" for blackout plants—no light transmission or reflection in blackouts. No protective housing or elaborate roof supports. Built to withstand weather. Light in weight. Designed to become a permanent part of the building. Constructed to keep out rain and snow.

Mail coupon for complete information. Learn how Carrier War Plant Ventilators can be used to advantage in your plant.

CARRIER CORPORATION, Syracuse, N. Y.

Please send literature on Carrier War Plant Ventilators. Desk 53D

Name.....

Company.....

Address.....City.....

Carrier

ARMY (E) NAVY

AIR CONDITIONING • REFRIGERATION

Single Cylinder Horizontal
"Universal Unaflow"

A Power Tale of Four Cities

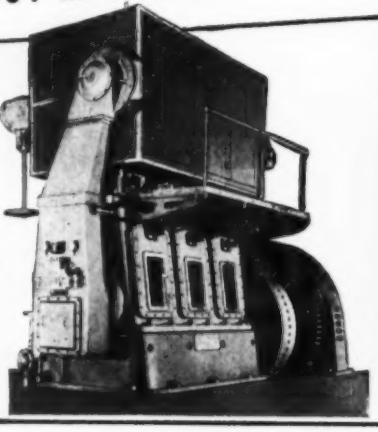
IN these widely separated cities Skinner "Universal Unaflow" Steam Engines are making sizable savings in power costs. Electricity is being generated at a much lower cost than if it were purchased from the local utility companies. Exhaust steam is used for space heating or process purposes.

These are not unusual cases. In practically every known industry similar savings are being effected where far-sighted management is using Skinner engine-generating equipment. Although you may have a seemingly low *rate per kilowatt-hour* for purchased power, it will pay you to investigate, for postwar planning, how much lower your *cost* could be for power generated by Skinner "Universal Unaflow" Steam Engines.

At present we are engaged entirely in building engines for the War Program, but our engineers are always available to discuss planning for the future. Case studies pertaining to your particular industry will be sent upon request.

BUY MORE WAR BONDS

Multi-Cylinder
Vertical
"Universal Unaflow"



Proudly we fly the Army—Navy "E" Flag, awarded for excellence in production

HOSPITAL

Modern metropolitan hospital in Pittsburgh, Pa. Electric power generated by three horizontal "UNIVERSAL UNAFLOW" Steam Engines driving 3-wire D-C generators, of 700 kw. total capacity. Steam pressure 150 psi., sat.; back pressure 1-5 psi. Installed in 1931.

TEXTILE PLANT

Typical New England woolen mill in Rockville, Conn. Main generating unit is horizontal "UNIVERSAL UNAFLOW" Steam Engine and 625-kva. 2-ph. 60-cy. 480-volt A-C generator, V-belted exciter. Steam pressure 135psi., sat.; back pressure 0-7 psi. Installed in 1941.
(This company has four additional "UNIVERSAL UNAFLOW" engines in other plants.)

HOTEL

Prominent 1000-room hotel in Columbus, Ohio. Power requirements of hotel and adjoining office building generated by three multi-cylinder vertical "UNIVERSAL UNAFLOW" Steam Engines with 250-volt D-C generators. Total capacity 1400 kw. Steam pressure 150 psi., sat.; back pressure 0-5 psi.
Installed in 1930.

PRINTING PLANT

Large Chicago printing plant (partial view) making its power with three 250-volt D-C generators driven by horizontal "UNIVERSAL UNAFLOW" Steam Engines, 1000 kw. total. Steam pressure 140 psi., sat.; back pressure 1 psi. First unit installed 1926.

SKINNER ENGINE COMPANY FOUNDED IN 1868 **ERIE, PA.**

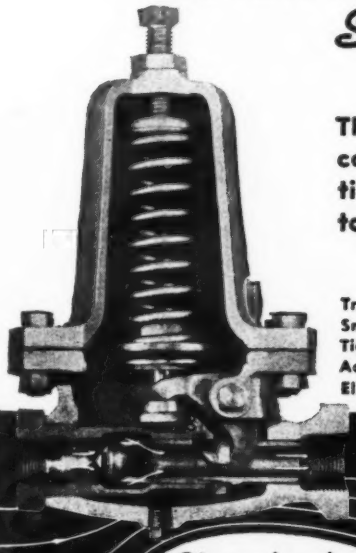
A LONG LIFE and a busy one..

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE **REDUCING VALVE**

●Long life, and busy too, because this type "1000" valve does not fail—it's as dependable when production continues at high rate, like today, as when things are normal. Streamliners in thousands of plants these past years—and still serving well proves this. One user wrote, "We could not afford to take chances on time out for job repairs, that is why we used your valve on this job."

No trouble from lack of capacity with this valve! Even under peak load, or sharp changes in demand, the aspirating effect gets the valve wide open for maximum flow. Users know this and will vouch for it.

Write today for Bulletin 1000—eight pages of valuable valve facts.



Streamline Design means

LESS MECHANISM

The elimination of small ports and passages and complicated mechanism with but few close fitting parts gives you more in service and adds to the life of the "1000" valve.

NET RESULT TO YOU

- Trouble-free service
- Smooth operation
- Tight closure
- Accurate regulation
- Elimination of failures
- Constant delivery pressure
- No spoilage
- Practically zero in maintenance costs
- Speedier production results
- Cost saving operation

Streamlined FOR SMOOTH, EVEN FLOW OF STEAM, WATER, AIR, OIL, ETC.

TURBULENCE ELIMINATED

The streamlined form of the inner valve produces the flow pattern shown here. It is the reason users of the "1000" valve get maximum capacity when it is needed most and accurate pressure control even when production hits non-stop proportions and operating conditions really are tough.

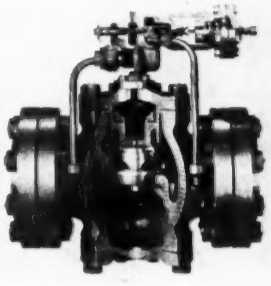
A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS.. VALVES

A CASH STANDARD "GET ACQUAINTED" COLUMN

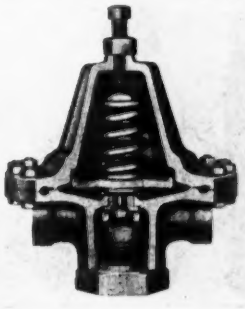
Question: "Don't you people make anything besides that Streamlined Valve you talk about so much?"

Answer: "Yes Sir; we do! And we propose to picture one or two of them here each time."



Cash Standard Type 11 Regulator, for use with water, air or any gas or oil that is non-corrosive. Pressure to actuate pilot valve may come from any source; and be as high as 1500 lbs. Variety of uses, notably as condenser water regulator.

Inlet pressure up to 600 lbs.; outlet pressure up to 250 lbs. Bodies: iron, bronze, steel. Trims: iron, bronze, stainless steel. Screwed, flanged, or ammonia type ends. Sizes: 2" to 12"

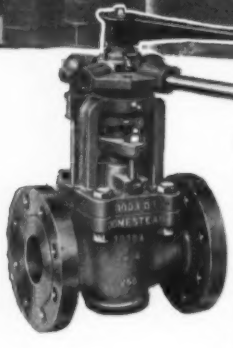


Cash Standard Type 8871 Pressure Reducing Valve; for use with liquids—especially dirty liquids, like Bunker C fuel oil for example. No sliding fits; inner valve bolted to diaphragm for positive movement.

Initial pressure up to 250 lbs., reduced pressure up to 200 lbs. Bodies: iron, bronze or steel. Renewable inner valve and seat ring, stainless steel. Sizes: ½", ¾", 1".

Get Free Bulletins on Above . . . Write to
A. W. CASH COMPANY
DECATUR, ILL.

Don't get caught with your *plants down!*



Here's *plain talk* about the so-called valve shortage.

From the start let's face the fact that valves are *hard to get.* But *you* have to get them . . . and *we're* working the clock around to see that you do.*

On time? When you want them? That's a different story . . . *and the happy ending is up to you!*

Positively there is *no valve shortage* . . . only a shortage of *time* to fill everyone's requirements *at once.* Ask us to fill immediately an order for ten or a thousand special specification valves, on the highest possible priority (not a directive), and we'd have to say "sorry." Give us the same order for valves you know NOW will be needed some months hence and we may even "beat the promise."

The answer to the "valve shortage" problem is this simple: *your* purchasing practices may need to be revised as much as *our* production procedure has been! The decades-old habit of ordering valves, pipe and fittings *last* must be *reversed.*

Until the valves are in the line the plant stays "down." Order at the blueprint or construction stage... not when the roof's on!

*(*Production increased nearly 800% in 12 months*).*

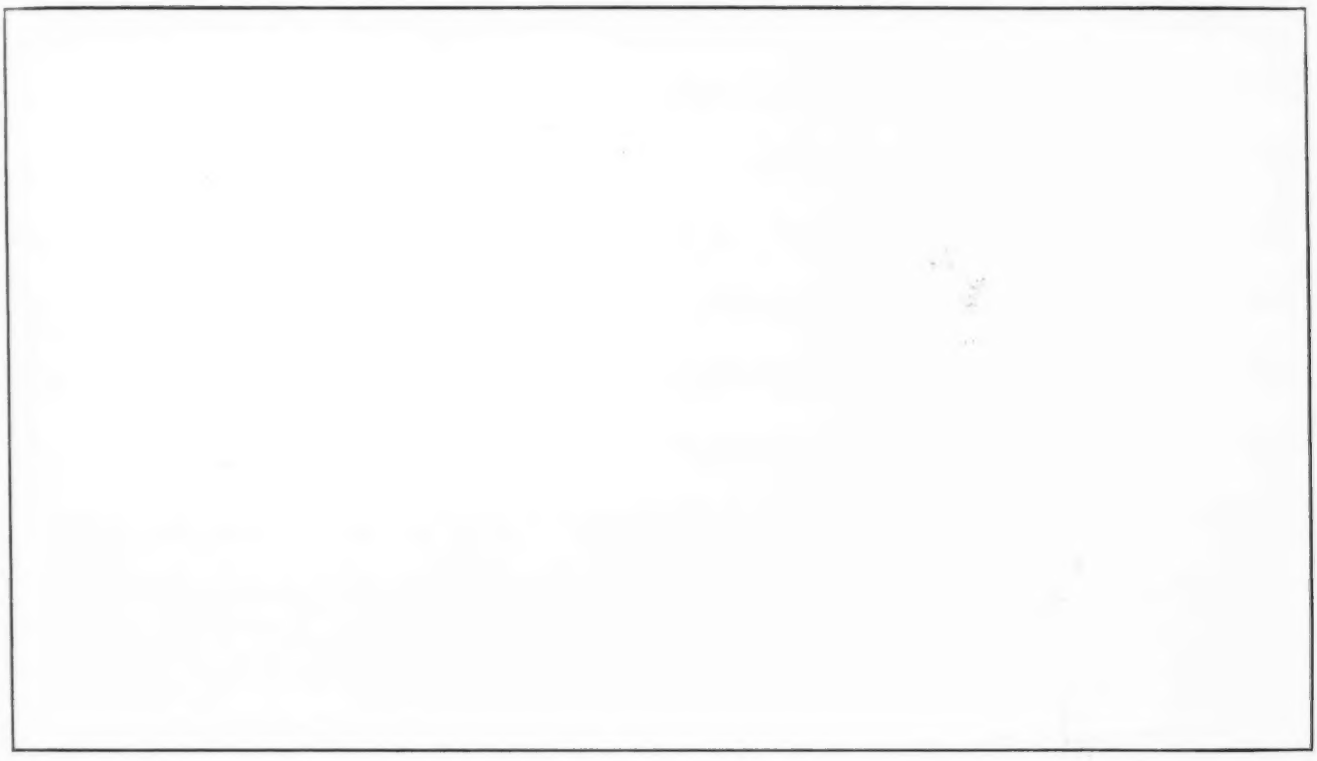
Maritime's two-flag, highest production award to our men and women making valves for the Victory Fleet.

Reference Book No. 38 shows standard types, sizes, and uses of Homestead Valves. Write for your free copy now.

HOMESTEAD VALVE MFG. CO.

P. O. BOX 210 . . . . . CORAOPOLIS, PENNSYLVANIA

IS THIS A CLOSE-UP OF YOUR POSTWAR PLANS?



DON'T be discouraged if your postwar plans are a complete blank. The way to start planning is to start—right now! And Taylor Instruments can help you get started—without interfering in the slightest with the No. 1 job of winning the war!

We say this for just one reason—because Taylor Instruments are *built* for quick conversion to new applications. With their unit construction and interchangeability of parts, they can help you change almost overnight to whatever new uses you may wish to put them after the war.

And that's important, not only to you but to the whole country, because a quick conversion to peacetime production may be *our one real hope of postwar prosperity!* Many government and business leaders are agreed on this point.

We don't mean to imply that you can solve your whole postwar planning problem with a couple of Taylor Fulscope Controllers and a Taylor Aneroid Flowmeter! But we know Taylor Instruments can help—just as they are now helping thousands of plants take wartime production changes in their stride.

So when you make your postwar plans—keep Taylor Instruments in mind! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow, and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS ★

"Buddy, meet an old friend"

You who use this friendly, long-life wire rope here at home can imagine what it would mean to you. Old side kicks who used to work with you are now in distant parts. If ever dependability counted in wire rope, it's doubly vital there. So when a Wickwire-rigged Liberty Ship gets through to them, and from its cargo unloads this reel with the friendly, trusted name, you can be sure it brings cheers.

The boys out there came from every American industry. They know that *you* need Wickwire Rope, too. So they're mighty thankful when you make what you have last longer, so that more can be spared for new shipping and for *their* heavy work along the fronts.

But when you do need more wire rope, please order it without reels, if lengths will permit, so our boys can have this greater convenience. Will you? Wickwire Spencer Steel Company, 500 Fifth Ave., New York, N.Y.

First Maritime M and Victory Fleet Flag in all New England was awarded to Wickwire for outstanding production achievements.

DO YOUR MEN UNDERSTAND STRETCH?

The free book, "Know Your Ropes," tells them just what to expect, and what to look out for. In addition it pictures splicing methods, life-extension rules, etc. This book can save you money—and save wire rope for the war fronts. Send for your free copy.

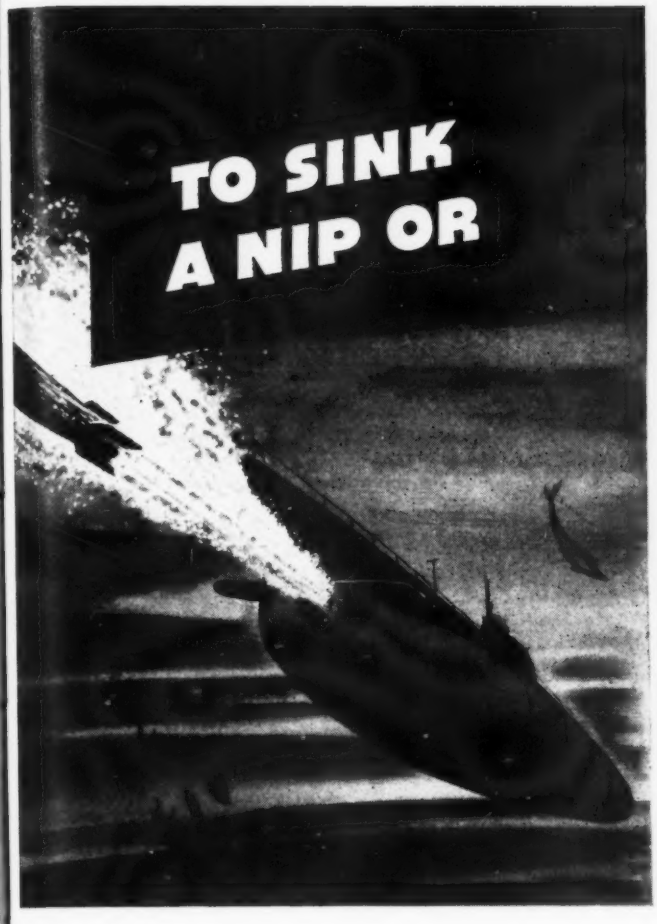
SEND YOUR WIRE ROPE QUESTIONS TO WICKWIRE SPENCER

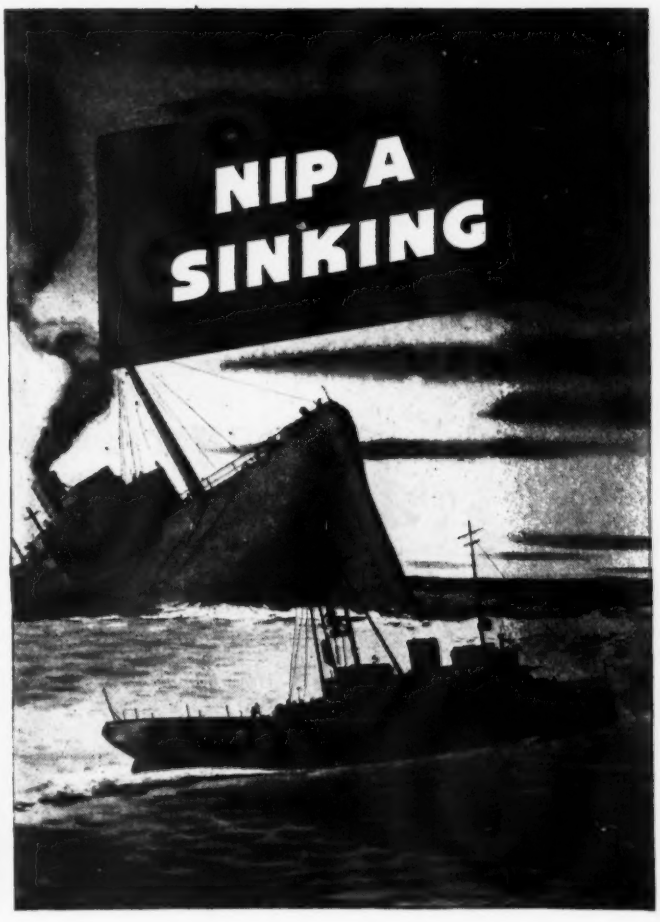
WICKWIRE SPENCER STEEL COMPANY

WICKWIRE ROPE

Sales Offices and Warehouses: Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles, Tulsa, Chattanooga, Houston, Abilene, Texas, Seattle. Export Sales Department: New York City

WISSCO PRODUCTS





. . . the Navy uses RPM DELO!

The men who fight in U. S. Navy submarines believe that Japan is entitled to half the Pacific—the bottom half! That's where they're sending thousands of tons of enemy shipping.

But this isn't a one-way war. Many of our ships have been damaged, too—and would have sunk except for rescue by one of the Navy's ocean-going tugs. These sturdy ships are vital units of the Fleet, constantly on the alert to hold down our losses by towing crippled ships to bases where they may be repaired to fight again.

Submarines and tugs of the Navy both use RPM DELO to lubricate their powerful Diesel engines. So do other types of Navy craft. Day in and day out, RPM DELO in Navy Diesels is meeting and beating some of the toughest lubricating problems in history.

In *your* Diesels, too, RPM DELO will give dependable protection, freedom from ring-sticking and sludge trouble. No other oil combines its anti-oxidant, cleaning and non-corrosive properties. Switch now to RPM DELO.

STANDARD OIL COMPANY OF CALIFORNIA

RPM DELO
REG. TRADE MARK
DIESEL ENGINE LUBRICATING OIL

ORDER RPM DELO FOR YOUR DIESELS

RPM DELO is marketed under the following names:
RPM DELO • Caltex RPM DELO • Kyso RPM DELO
Signal RPM DELO • Imperial-RPM DELO • Sohio RPM DELO
CONCENTRATE
Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your vicinity

She keeps steel mills Rolling . . .

THIS little Flexomotive is a regular maid-of-all-work in a Mahoning Valley steel mill.

She does a hundred and one hauling jobs equally well—such as switching and spotting freight cars, delivering scrap, limestone and other raw material to the charging floor, moving molten metal in ladle cars, shifting ingot molds to and from pouring stations, and hauling hot slag to the dumping grounds.

Like all Plymouth Flexomotives, she is direct-driven with a powerful Cooper-Bessemer diesel—quick to accelerate and decelerate, efficient on heavy loads or light, economical in fuel consumption, clean and easy to operate.

It is because of this extreme flexibility and economy that more and more, steel mills and metal plants are swinging to diesel power—and to Cooper-Bessemer powered locomotives in particular.

Locomotive Diesels
Marine Diesels
Air and Gas Compressors

Stationary Gas and Diesel Engines for Industry

A 65-ton Plymouth Flexomotive helping an Ohio steel plant turn out more production for war. Powered by a Cooper-Bessemer diesel.

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO GROVE CITY, PENNA.

New York Washington Tulsa Dallas St. Louis Houston Los Angeles Seattle Shreveport

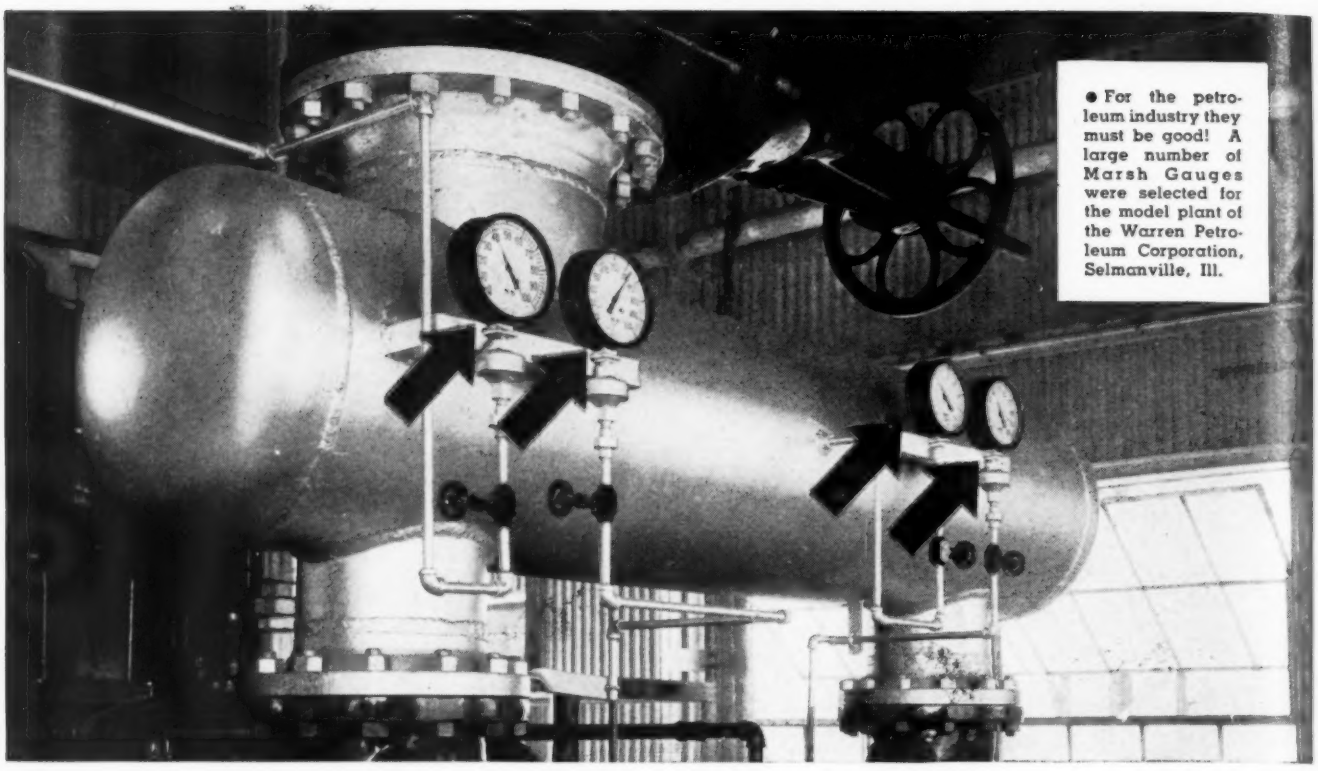
ELECTRONIC Instruments in the industrial plants of tomorrow will supply that life-blood of change and improvement which makes for scientific progress and commercial success.

To anticipate the exacting demand of industry's future instrumentation, Brown and Minneapolis-Honeywell engineers have assumed the obligation of leadership in pioneering new developments for the measurement and control of industrial processes.

THE BROWN INSTRUMENT COMPANY, 4490 WAYNE AVENUE, PHILADELPHIA, PENNSYLVANIA
DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.
MINNEAPOLIS, MINNESOTA, AND 119 PETER STREET, TORONTO, CANADA
Wadsworth Road, Perivale, Middlesex, England — Nybrokajen 7, Stockholm, Sweden

Instruments by **BROWN** *and Controls by*

MINNEAPOLIS-HONEYWELL



● For the petroleum industry they must be good! A large number of Marsh Gauges were selected for the model plant of the Warren Petroleum Corporation, Selmanville, Ill.

Who builds the best pressure gauges?

PERHAPS it wouldn't be fair for *us* to answer that question—but it *is* a fair question. It's the kind of question that bobs up in the mind of every man who buys, specifies or uses equipment of this kind. The answer to it is important to you, so we suggest a few ways in which you can sift it down to the *right* answer.

First of all, consider the fact that Jas. P. Marsh Corporation has been making gauges and similar instruments for more than 75 years. That could mean much or little, but everything being equal it should mean much. And the best way to find how much it means is to *examine* Marsh Gauges.

If you do, you will find that they always incorporate design and construction that adapts them to the job at hand—construction that could only have been taught in the hard school of experience. You will find, moreover, that this finer construction is not confined to the most expensive Marsh Gauges, but is common to all of them in relation to the services for which they are built.

But perhaps you don't need to examine the Marsh product. Perhaps you are on speaking terms with a Marsh Gauge, Dial Thermometer or Heating Specialty that has long since given you the answer to "Who builds the best?" in the plain language of lasting accuracy. If so, you know why we have no hesitancy in asking the question . . . and leaving the answer to the Marsh Product!

The Gauge with the "RECALIBRATOR"

Even the best gauge can be knocked out of adjustment—but if it's a Marsh, a twist of the "Recalibrator" screw restores its accuracy throughout its *entire* scale. This is the only basically sound way to correct a gauge that has been thrown out of adjustment. The advanced Marsh "Mastergauge" is illustrated above. There is a type of Marsh Gauge, Dial Thermometer or Recorder for practically any service.

Marsh Instruments are available for essential uses.

JAS. P. MARSH CORP., 2075 Southport Ave., Chicago, Illinois

MARSH GAUGES

DIAL THERMOMETERS . . . RECORDERS . . . HEATING SPECIALTIES

The oldest manufacturer—the newest ideas

Announcing

A Dust Collector Made of Non-Critical Materials

Here is the most revolutionary and important dust collector news of the year! A dust collector made entirely of non-critical materials, which can be *delivered now without a priority*.

Instead of using steel for the tubes of this new Thermix Ceramic Dust Collector, they are made of tough fire clay. These tubes are sufficiently thick and rugged to be proof against fracture and breakage from normal handling and temperature changes, and they can be replaced with standard shapes if necessary. They weigh no more than steel tubes.

The Thermix *Ceramic* Dust Collector possesses all the features that have made Thermix Dust Collectors famous, for more than 17 years, for their high dust collecting efficiency and long trouble free and economical operation. It assures the collection of practically all fine pulverized fuel fly-ash except a small percentage of the ultra-fine, low-carbon dust, which is the least objectionable.

The first cost is moderate and it costs practically nothing for maintenance. Can be easily installed in small space in new or old plants . . . and will even operate satisfactorily outside of a plant without a protecting structure.

Thermix Steel-Tube Dust Collectors are now in operation in connection with more than 40,000,000 lbs. of steam capacity per hour.

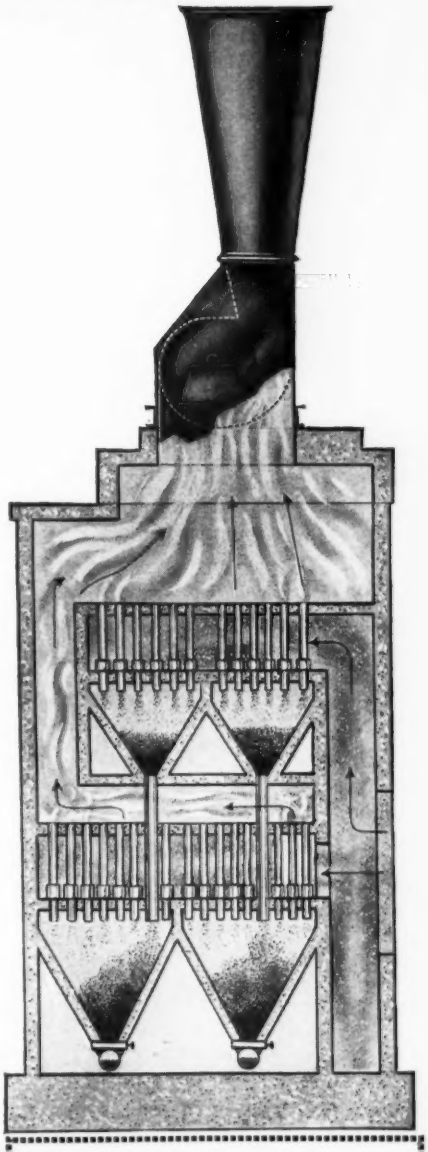
Write for full particulars, or mail the coupon.

PRAT-DANIEL CORPORATION, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities



Thermix Ceramic DUST COLLECTOR

PRAT-DANIEL CORP.
88 S. Water St., Port Chester, N. Y.

Without obligation on our part you may send details about the Thermix Ceramic Dust Collector.

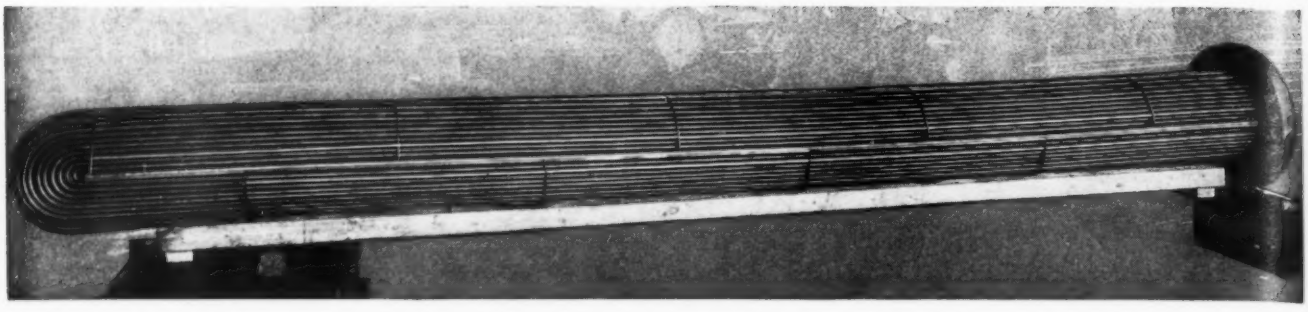
NAME .....

ADDRESS .....

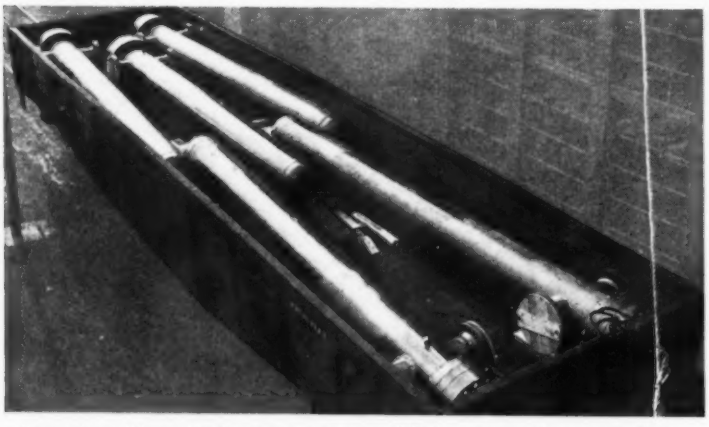
CITY..... STATE.....

WHITLOCK

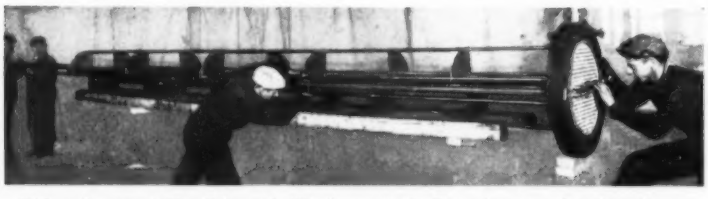
Manufacturers of Heat Transfer Equipment Since 1891!



Whitlock Standard U-Tube Construction for Heat Exchangers and Extraction Feed Water Heaters Has Practical War-Time Value—Saves Material, Machining, and Assembly Time!



Complete Heat Exchangers—note welded rear end construction.



U-bends carefully "threaded" through baffle plates and tube sheet.

Tube Section in Shell—ready for pressure testing of welded shell.

For years Whitlock Heat Exchangers, Feed Water, Fuel Oil, Instantaneous, and Service Water Heaters have featured U-tube heating sections (though all types specified by customer have been and are made).

The obvious advantage of the U-tube is the elimination of trouble due to different expansion of section and shell—the U-tube section expands or contracts independent of the shell. Its resulting advantages, always important, are even more practical in war time. Materials used in alternate constructions are saved—such as floating tube sheet, floating head and rear head of shell. Valuable time used in machining these parts and in assembly is saved as making U-bends and welding shell ends takes substantially less time.

All this helps to get vital war units at work quicker; the one aim of the whole Whitlock organization. Can we help you? Write fully.

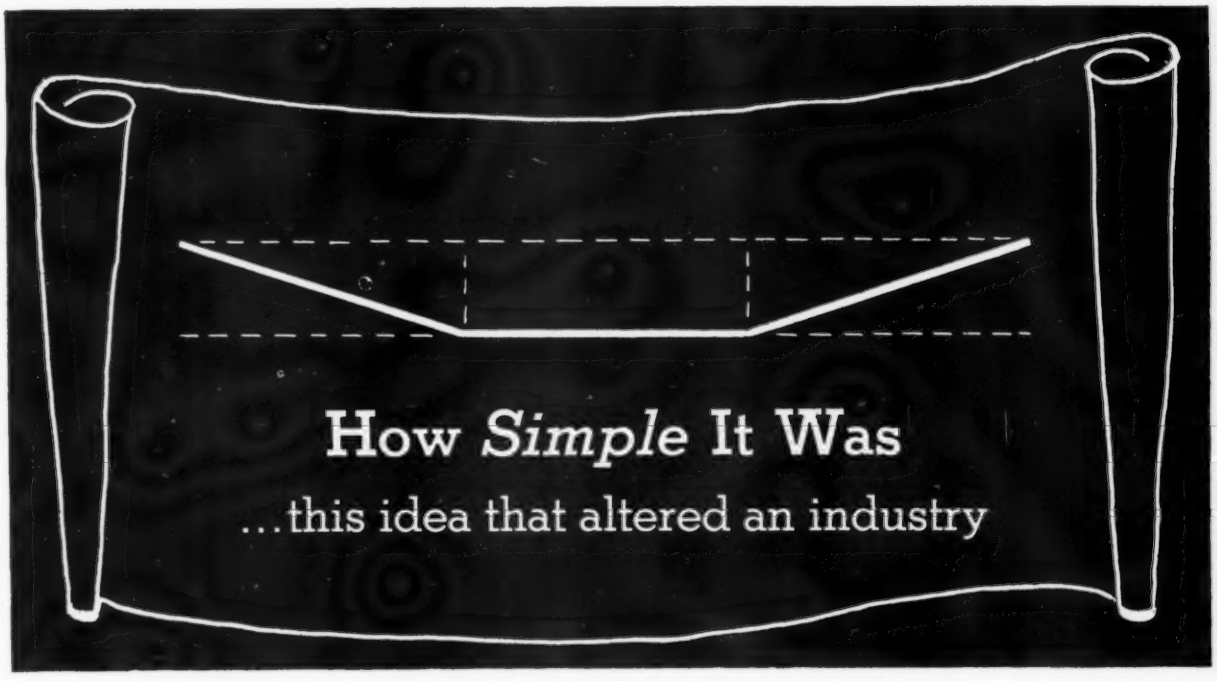
THE WHITLOCK MANUFACTURING COMPANY

46 SOUTH STREET, ELMWOOD, HARTFORD, CONN.

District Offices in

NEW YORK CHICAGO BOSTON PHILADELPHIA DETROIT RICHMOND

Long the Leader . . . Ever a Pioneer



MIRACLES are usually modest; they seldom clamor for attention. Yet their effects can sometimes change an entire industry.

At least, that is what happened when Thomas Robins developed his second invention. Having made the first belt created especially for conveying materials, Mr. Robins was still not content. He felt that further improvement was necessary . . . that a belt running *flat* was wasteful; it carried only a limited quantity of material and usually dropped much of that material along the way. So his fertile mind attacked this second problem.

The First Troughed Belt Conveyor. The first step was to try running a belt in a trough formed by spool-shaped idlers. As could be expected, the varying diameters of the spools caused friction which quickly destroyed the underside of the belt. Then Mr. Robins invented the Troughing Idler so common today—cylindrical pulleys set on angle brackets to raise the sides of the belt.

The present firm of ROBINS has an extensive department devoted to the manufacture of all types of Idlers: Troughing, Training, Rubberdisc and Return. All types possess the customary ROBINS qualities: efficiency, economy, endurance. Careful buyers—everywhere—prefer them.

ENGINEERS • FABRICATORS • ERECTORS
OF
MATERIALS HANDLING MACHINERY

ROBINS
CONVEYING BELT COMPANY
PASSAIC • N. J.

For Material Aid in Materials Handling . . . It's ROBINS

WeldELLS have everything ★

Every WeldELL can pass this test!

YES, every WeldELL* can pass this test for true circularity—or any other test for dimensional accuracy. A number of steps in their production contribute to this uniform accuracy, and as a final precaution every fitting is given a special truing operation to bring it to exact size before machining bevels and lands.

Why do we go to all this extra trouble just to provide a little greater dimensional accuracy in a rugged thing like a welding fitting? The man who uses WeldELLS knows the answer to that question. He has found that the extra lengths to which we go to achieve greater accuracy pays dividends in time saved on the job—results in better and faster welding.

Check down the list of WeldELL features and you will find that WeldELLS and other Taylor Forge Welding Fittings give you the means of doing every job as *well* as it can be done—as *easily* as it can be done—as *economically* as it can be done.

TAYLOR FORGE & PIPE WORKS
General Offices and Works: Chicago, P.O. Box 485
New York Offices 50 Church Street
Philadelphia Office: Broad Street Station Building

★ No other fittings for pipe welding combine the features found in WeldELLS. In addition to extreme dimensional accuracy these features include:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line** of Welding Fittings and Forged Steel Flanges in the world — insures complete service and undivided responsibility.

WeldELLS are only one of many Taylor Forge contributions to the war effort. For example: huge Rolled Steel Rings that are an important part of U. S. tanks now in action.

* *WeldELLS and many other Taylor Forge Products are produced in Byers Genuine Wrought Iron.*

FIT THE VALVE TO THE SERVICE

WHERE THROTTLING IS NOT REQUIRED

Walworth No. 95 Re-New-Disc Bronze Globe Valve saves time and trouble in changing discs because of the lock-on, slip-off disc holder originated by Walworth. It's an ideal globe valve for use where throttling is not required. General purpose discs are regularly furnished, and special discs are available for unusual services.

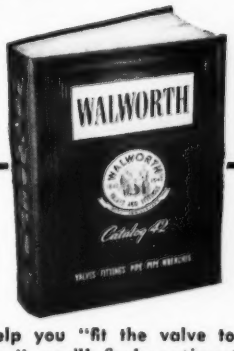
WHERE THROTTLING IS REQUIRED

Walworth No. 245P, with its hard plug type disc and seat, is designed for throttling service. It resists "wire drawing" and lasts longer. Like the No. 95, extra strength in the body-to-bonnet connection is obtained by the union bonnet design.

Walworth No. 95 and Walworth No. 245P are two excellent valves for general service. They are well designed, made to precision standards, and proved in the services for which they are recommended. They are engineered for specific purposes . . . No. 95 for general service, No. 245P for throttling service . . . and each has its distinctive features of design and construction. *Fit the valve to the service.*

ARMY E ARMY E NAVY

BOSTON AND KEWANEE PLANTS



To help you "fit the valve to the service," you'll find pertinent information on Walworth's *complete line* of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy.

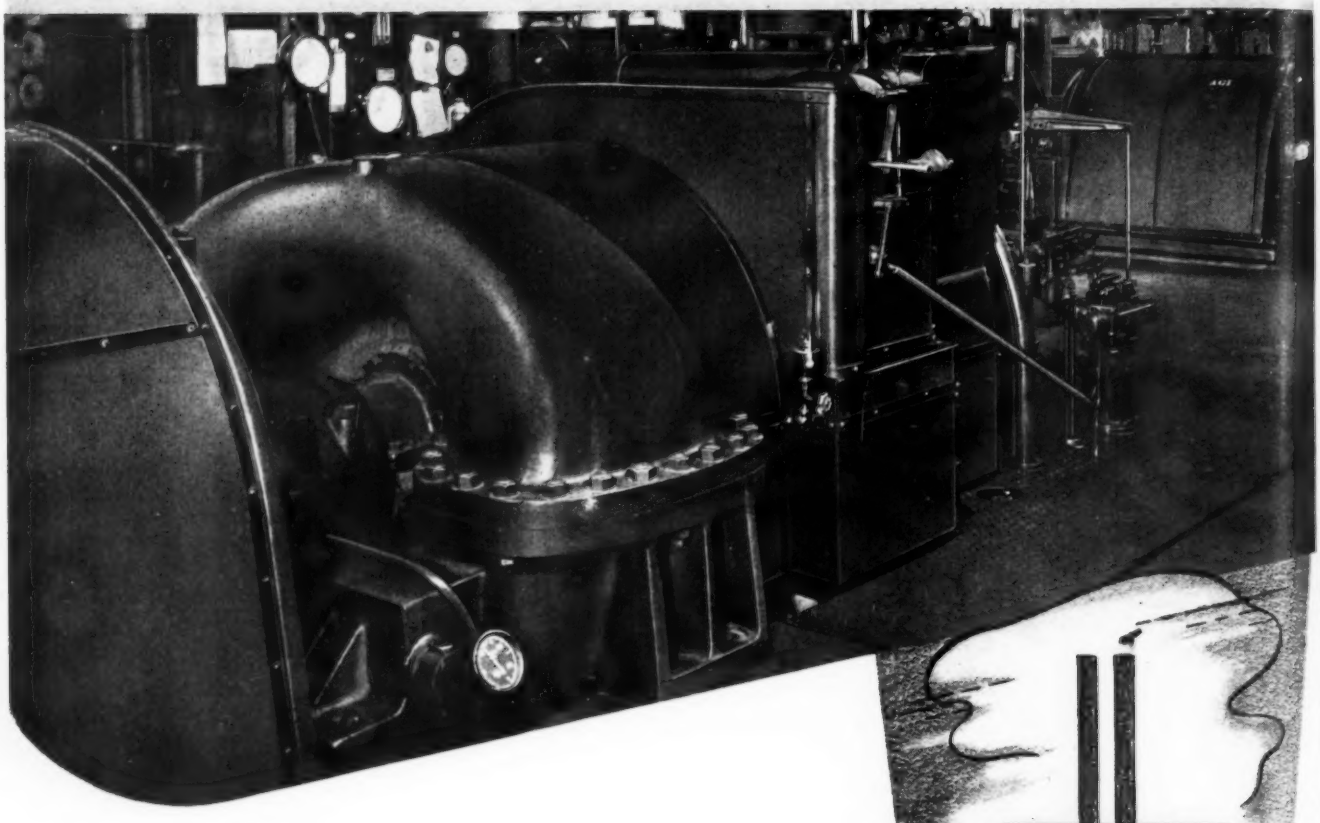
WALWORTH

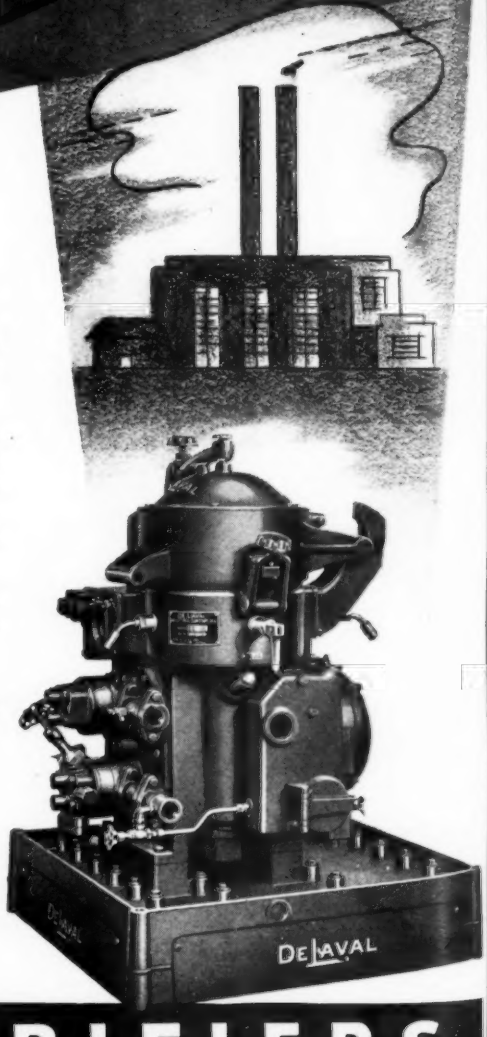
WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

VALVES FITTINGS and TOOLS
Backed by 101 Years' Service

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

THESE TURBINES *Must* SERVE FOR THE DURATION · · · *and* AFTER





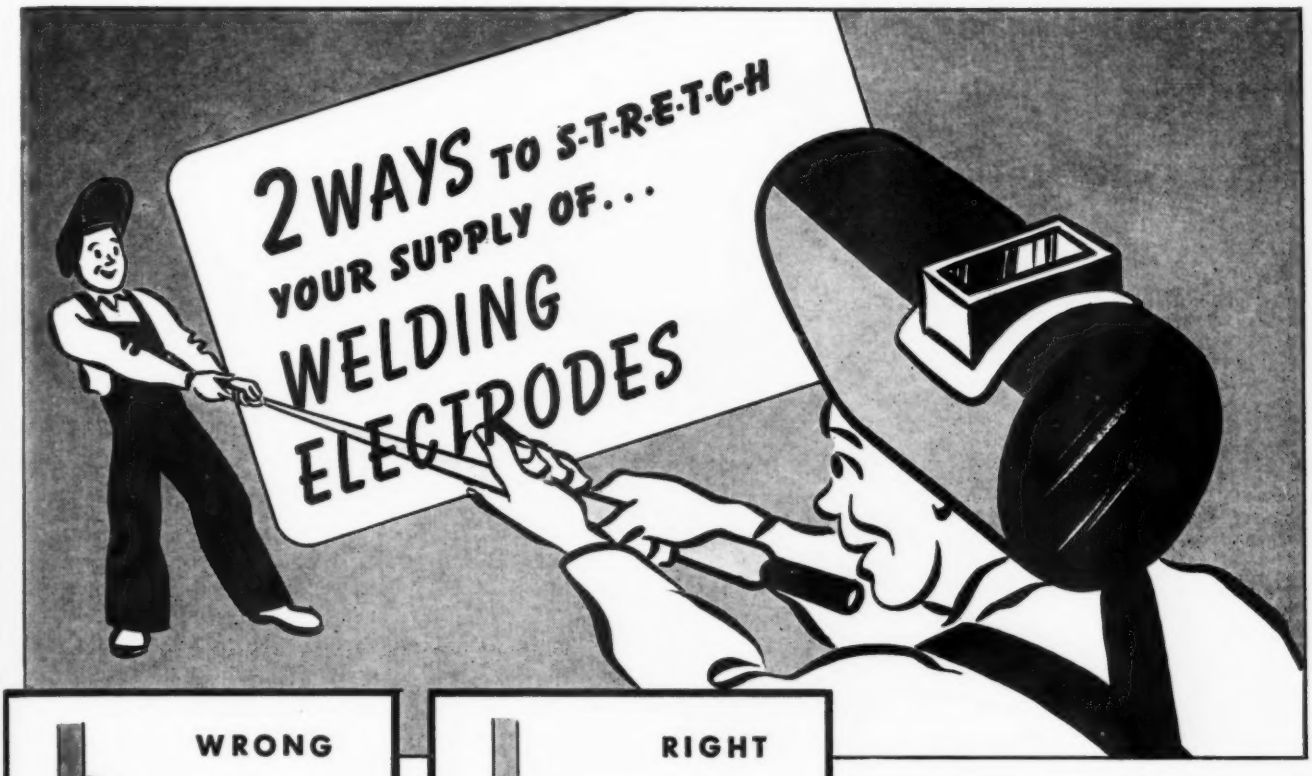
BECAUSE so much depends upon the continued efficient operation of the thousands of virtually irreplaceable generating units in central stations and private power plants throughout America, the protection which De Laval Oil Purifiers afford them is more than ever necessary at this time. Fortunately most of the larger of these units and hundreds of smaller ones already have such protection.

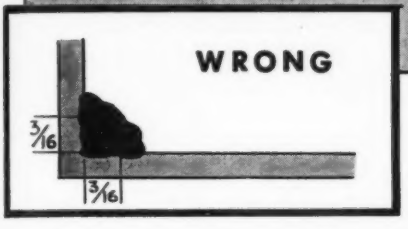
De Laval Oil Purifiers keep turbines and engines free from the two great sources of lubricating trouble: Water which can lead to oil failure and which also accelerates sludge formation; and dirt which causes excessive wear on bearings and other moving parts and in extreme cases may shut off the oil supply. Thus most of the danger of trouble with bearings and other lubricated parts is avoided when a De Laval Purifier is used.

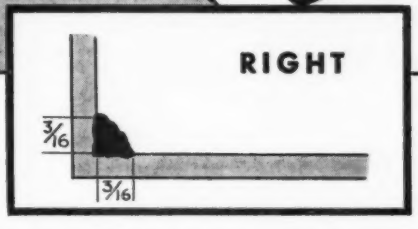
There is a De Laval Oil Purifier and system for every size and type of power plant. In writing, please state your particular problem so that De Laval engineers can be of utmost help—without obligation, of course.

THE DE LAVAL SEPARATOR COMPANY, New York, Chicago
DE LAVAL PACIFIC CO., San Francisco
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval OIL PURIFIERS







1. DON'T "OVER-WELD" FILLET JOINTS

If a job calls for a 3/16" fillet, don't pile on extra electrode metal to play safe. Proper joint design includes an ample safety factor, and exceeding design dimensions merely wastes electrodes. For instance, if dimensions are doubled—to 3/8" legs instead of 3/16"—four times as much deposit metal is used. Check with your fillet weld gauge whenever in doubt.

2. USE THE LARGEST ELECTRODE AVAILABLE

Using larger diameter electrodes speeds up deposition of metal, and choosing an 18" length instead of 14" means fewer electrode changes for a given length of weld.

Following this method will increase welding speed 25% to 50% and also save 3%-4% stub loss.

• These are only two ways to get the most useful work out of every electrode. More suggestions are shown below. Follow these rules and see that all your welders observe them. In this way you can stretch your supply of electrodes during the present shortage.

CONSERVE ELECTRODES FOR VICTORY!

Use electrodes down to a 2" stub
Make legs of fillet welds equal
Make face of fillet welds flat
Store welding electrodes in a dry place

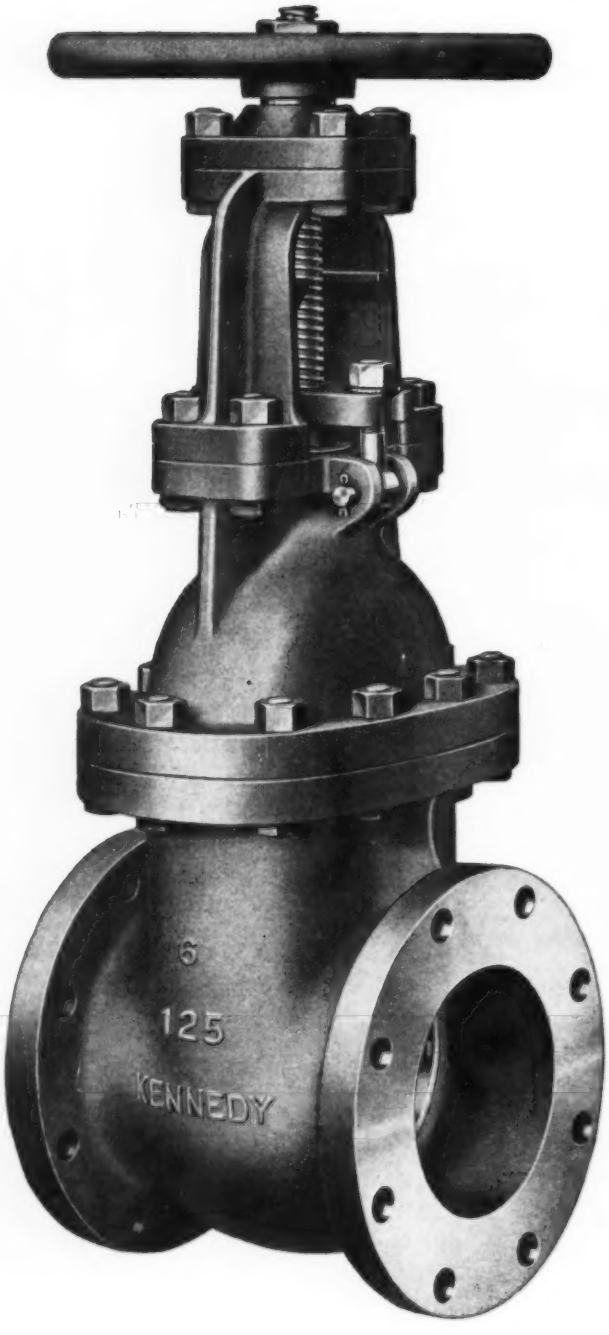
AIR REDUCTION

AIRCO

60 EAST 42nd STREET, NEW YORK, N. Y.
In Texas: Magnolia-Airco Gas Products Co.

Free copies of this poster available.

IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!



- **RELIABILITY**
- **STRENGTH**
- **ECONOMY**
- **SAFETY**

. . . characteristics of every **KENNEDY** *valve*

Kennedy Valves are reliable because of their simple, sturdy and effective operating mechanisms. Many of these mechanisms were originated by Kennedy, and have proven their effectiveness in thousands of installations.

These valves are economical because of their durability which has been demonstrated by decades of service in many installations without maintenance expense.

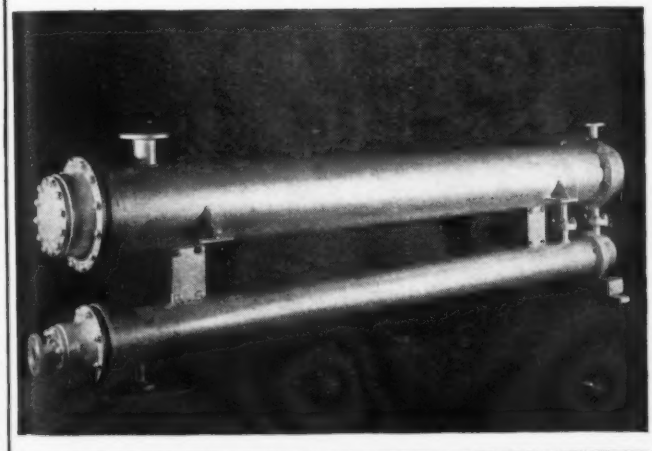
Their generous proportions of all parts, together with high-quality, high-tensile-strength metal, assure ample strength and complete safety. You are always safe with Kennedy "Extra Value" Valves.

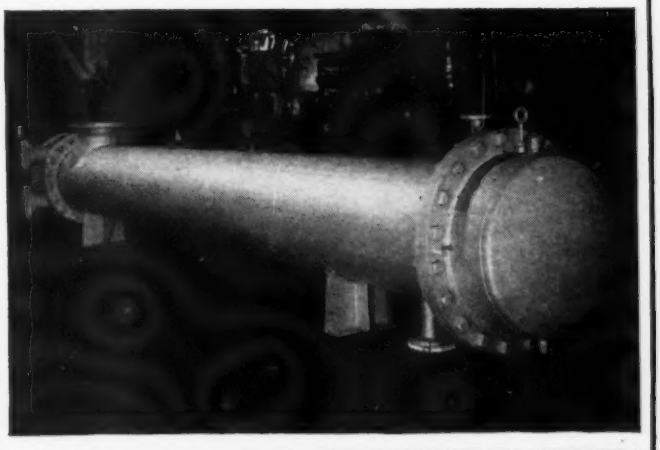
THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

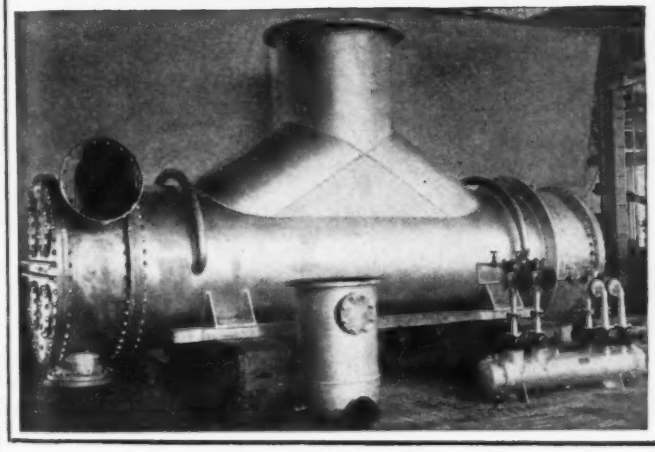
KENNEDY *valves . . . pipe fittings . . . fire hydrants*

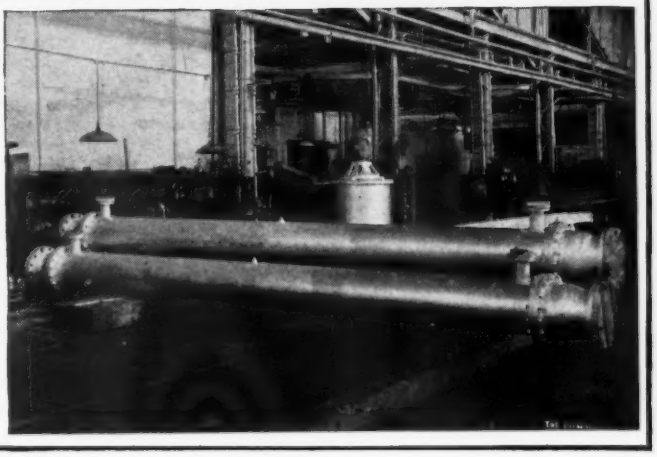
HEAT INTERCHANGE AND VACUUM EQUIPMENT

For Every Power Plant Need









Long the country's largest single purchaser of heat transfer equipment for the refineries, etc., which it designed and built for leading companies, Lummus four years ago began building its own. It did this in order to make available to its clients improved equipment of modern design and superior workmanship.

The services of Lummus engineering personnel and the facilities of the Lummus heat exchanger plant at Honesdale, Pennsylvania, are available to public utilities and industrial plants for the study of specific problems and the design of heat exchanger equipment to meet individual conditions.

★ SURFACE CONDENSERS
★ STEAM JET AIR PUMPS
★ BLEEDER HEATERS
★ BOILER BLOWDOWN HEAT EXCHANGERS
★ FUEL OIL HEATERS
★ LUBRICATING OIL COOLERS

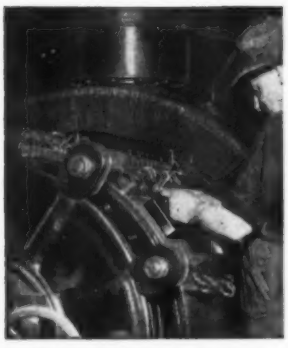
LUMMUS

THE LUMMUS COMPANY • 420 Lexington Avenue, New York, N. Y.

SHOP BULLETIN

Attention Electrical Maintenance Supervisor..

KEEP MOTORS HUMMING AT TOP EFFICIENCY WITHOUT DISMANTLING



Double Handle Resurfacer, on commutator of large rotary converters.

A few of the nearly 200 different types of IDEAL Resurfacers.

Sustained Production is more important right now than ever before. You can get sustained output from your motors and generators and prolonged life (years of continuous running *without* disassembling) by giving them periodic maintenance attention with the IDEAL products advertised below.

IDEAL RESURFACERS

SMOOTH UP COMMUTATORS AND SLIP RINGS

At the very first signs of wear on Commutators and Slip Rings—pin ridges, minute sparks, pits and burns — immediately use IDEAL Resurfacers. Don't even wait for any trouble to start, but use IDEAL Resurfacers periodically on all motors and generators. *No Dismantling Necessary.* Refinish Commutators and Slip Rings to a smooth, highly polished surface while they are turning over right in their own bearings. One man does the job. No delays or let-up in production. More than 175 styles and sizes of IDEAL Resurfacers to meet all conditions.

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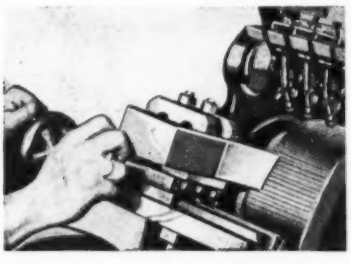
True Up Commutators and Slip Rings in Their Own Bearings

When commutators and slip rings are badly scored and grooved, or get very rough and out-of-round, IDEAL Precision Grinders will restore them to peak efficiency. *Without dismantling,* carry the (portable) IDEAL Grinder right to the motor. Mount it directly on brush arms and grind at normal operating speeds under machine's own power. Three models.



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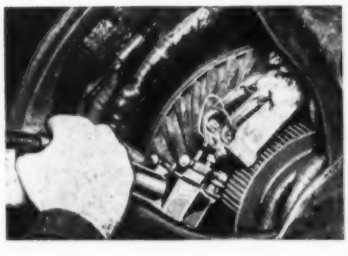
For Cutting High Mica

IDEAL (Portable) Undercutters cut the hardest mica. Three models are available. (1) *Direct Drive,* requiring no brush removal, (2) the compact *"Universal,"* and (3) the *Shop Model.*



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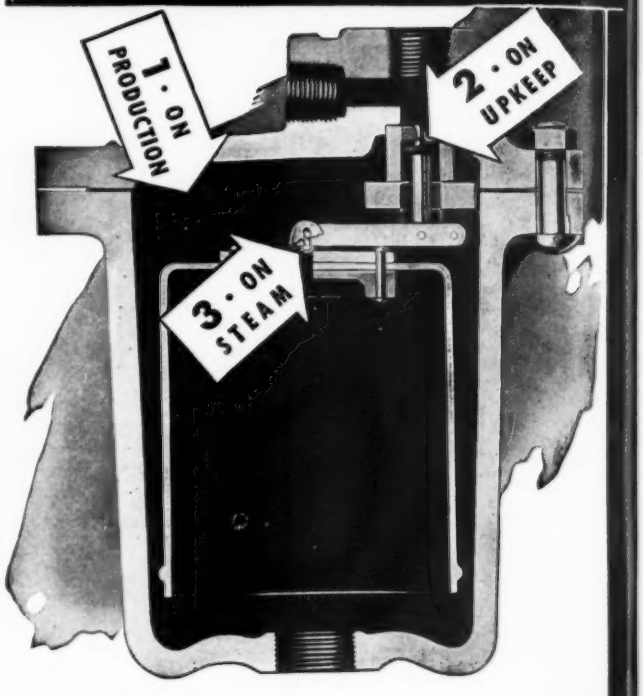
PIPEWRENCH PETE SAYS:

THESE 3 SAVINGS MAKE SENSE TO ME!



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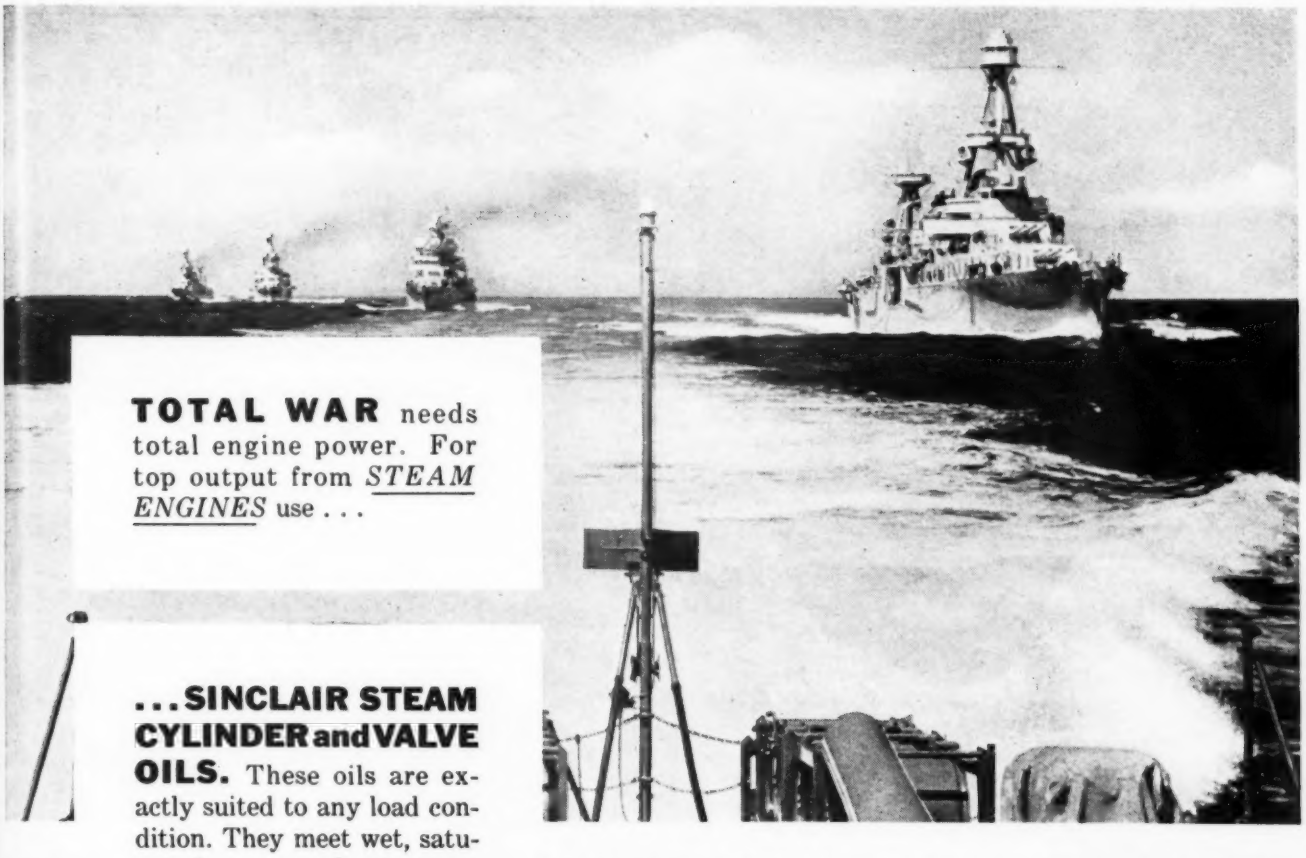
STRONG STEAM TRAPS



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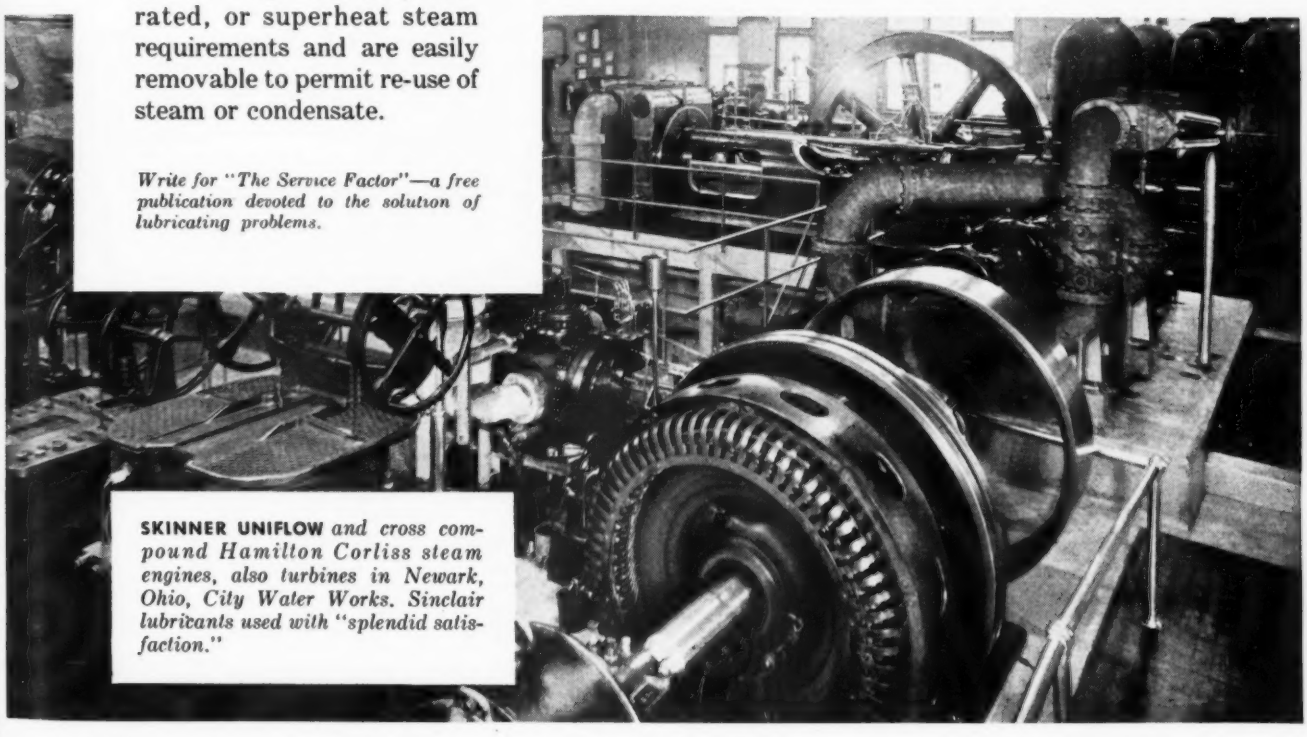

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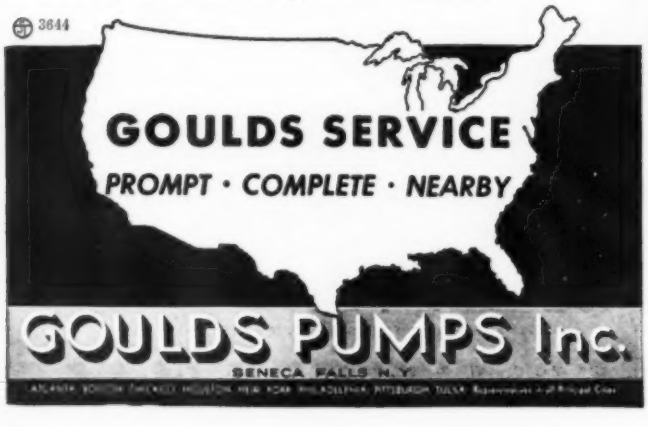
"Showing the ropes" to a newcomer is not always simple. But one subject can be easily covered. Questions about pumps of all kinds can enlist the help of Goulds—help which can save you long, time-consuming explanations.

Goulds furnishes a portfolio of question-answering pump data. This material was originally prepared for the confidential use of salesmen. It helps to select, install, operate and maintain pumps correctly and to lengthen the life of existing pumping equipment. As a wartime contribution, Goulds makes a copy available to all pump users who write for it.

Then, too, Goulds service remains available in all parts of the United States.

On land with the U. S. Army . . . at sea with the Navy and Merchant Marine, and in the building of bombers, many wartime jobs illustrate the range of services for which Goulds provides efficient pumps. The Goulds engineering and industrial line includes many standardized units. Bringing a variety of new problems, these war years are enriching an experience of 96 years, adding further value to Goulds postwar usefulness.



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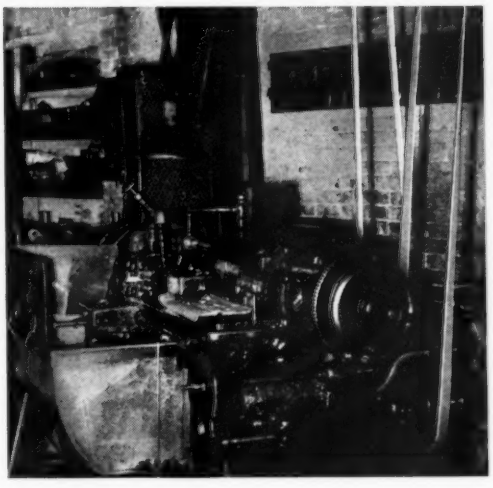

TANNATE leather belting gets extra production from almost any plant . . . For, Tannate carries full load; grips tightly, runs smoothly; keeps machines producing at full capacity even under varying load conditions.

TANNATE retains its unusual grip and great strength, even when exposed to high temperatures, machine oils, humidity, or weak chemicals. It has plenty of stamina for three-shift, seven-day-a-week operation. Tannate leather belting requires little attention other than an occasional application of Rhoads belt Preserver.

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WATERSHED LEATHER BELTING

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ELLIOTT

1300 Series TUBE CLEANER

More flexible to get easily around tube bends and curves. It's not only the strong Elliott universal joint just back of the cutter head — but it's notably the *new Elliott 1300 Series motor,* which naturally will take a bend of shorter radius. And the *new Elliott hinge coupling* — ingeniously simple, strong, air-tight in any position, which couples hose and cleaner, sliding easily to any required angle.

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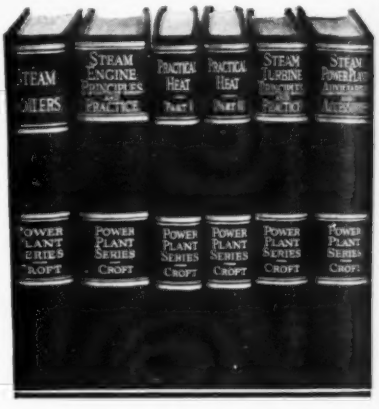

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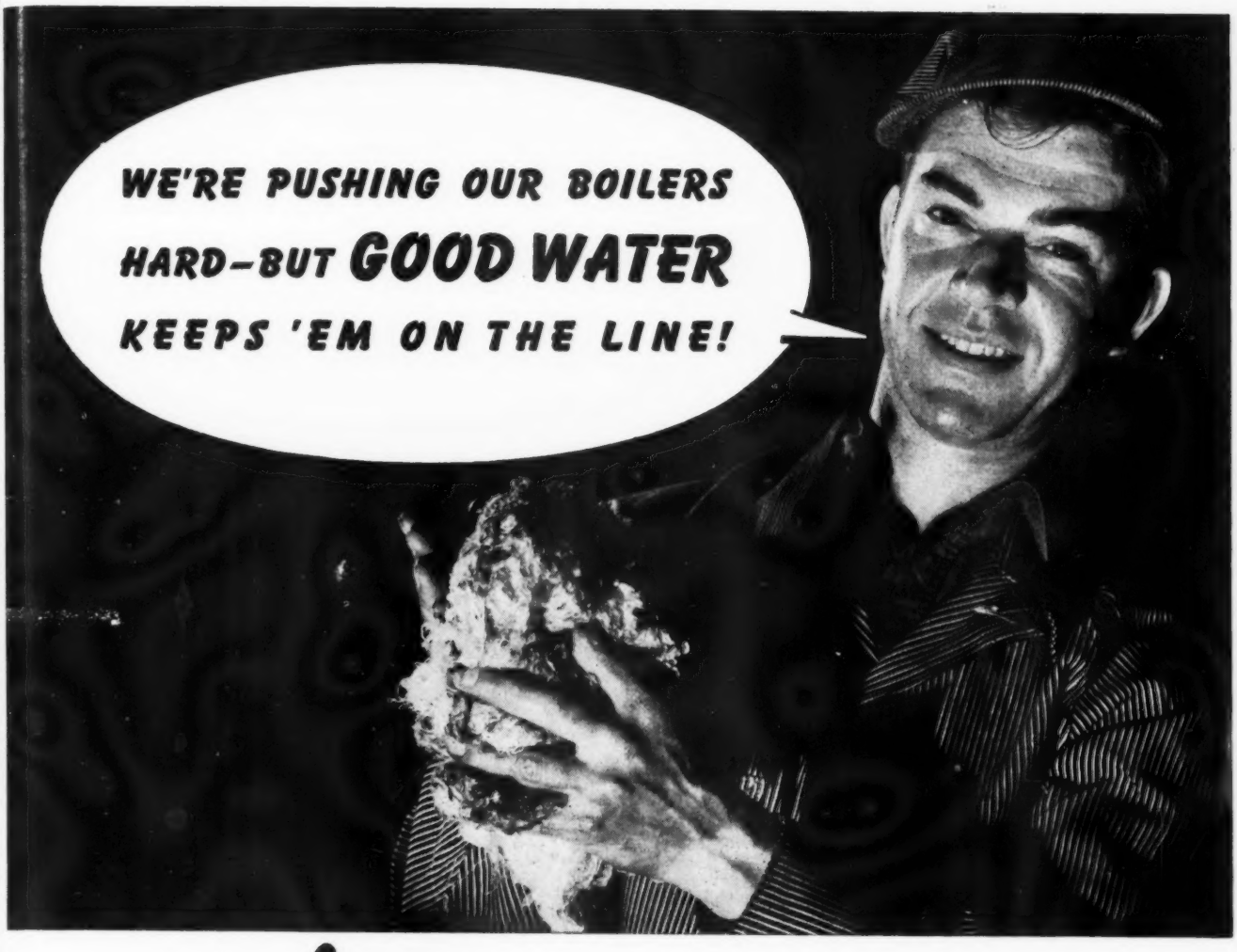

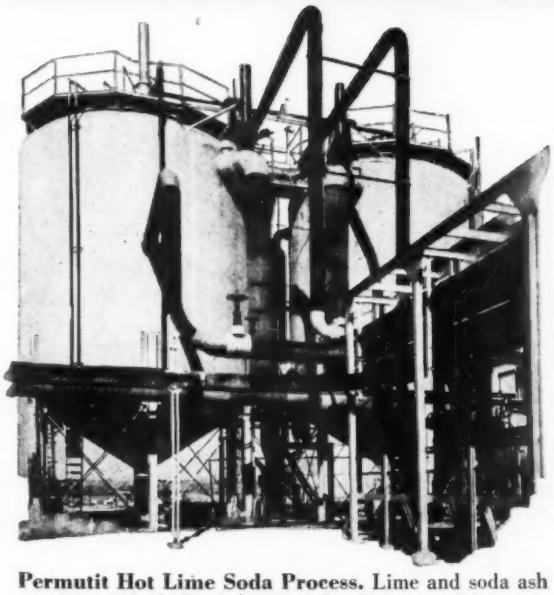

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Power plants everywhere are straining to deliver increased war loads. Scale and corrosion in boilers, steam lines and auxiliaries would mean wasteful shutdowns for turbining or replacement of tubes—when tubes may not be available.

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Permutit provides whatever process a particular plant requires: Zeo-Karb*, hot lime soda softeners, deaerating heaters, silica removal, demineralizing equipment, continuous blowoff equipment, etc. This individualized protection can help *your* plant make its maximum war contribution. Write to The Permutit Company, Dept. A, 330 West 42nd St., New York, N. Y.

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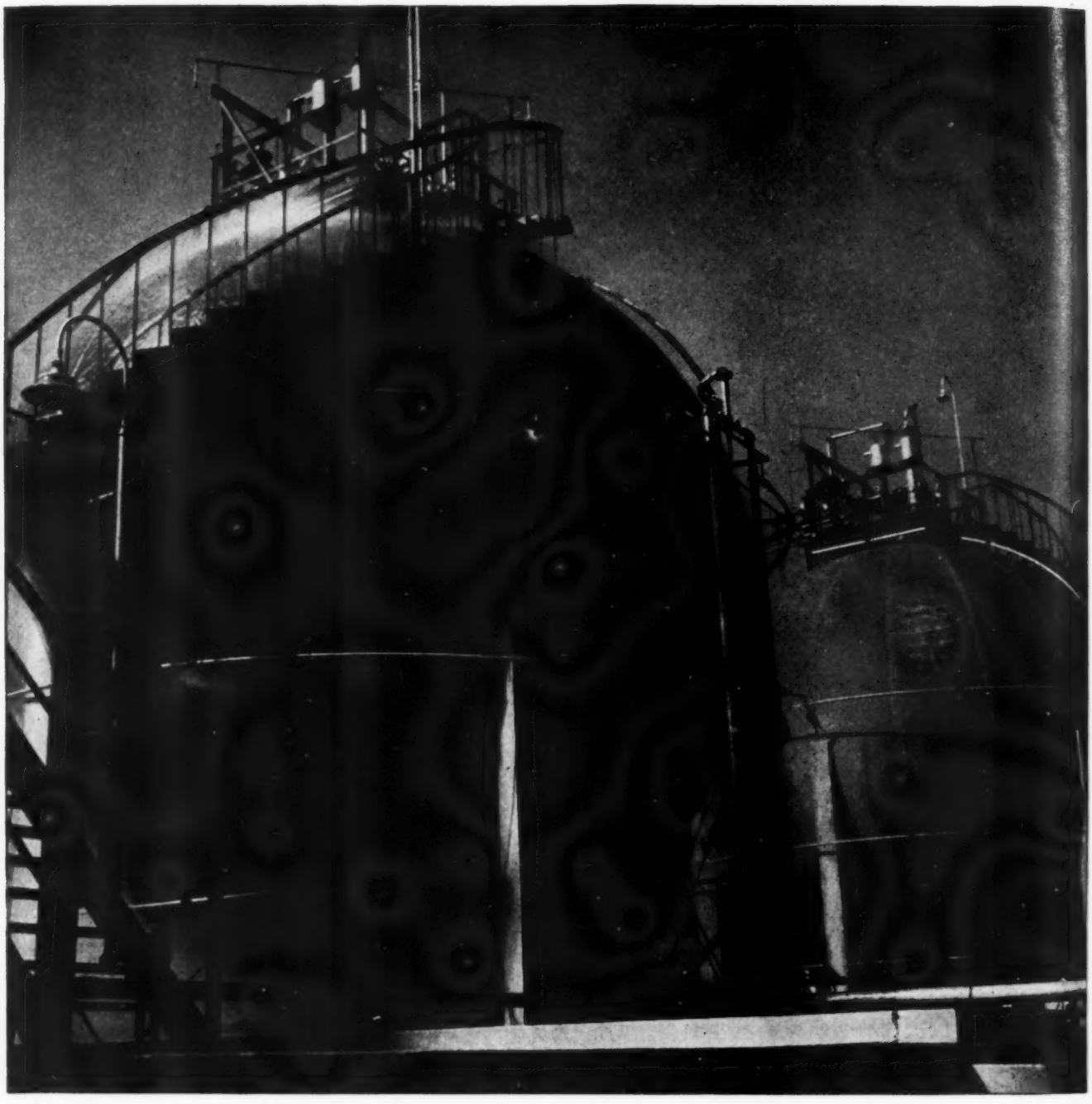

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Take a good look at these huge spherical tanks. Chances are your hose, your belts, your packings may come from them or from others just like them.

These are used for storing butadiene in the first of the synthetic plants operated by U. S. Rubber Company . . . a second will soon be in production.

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MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Laboratory Tests Provide Clues to Longer Tube Life

The research work which is constantly being carried on in Bridgeport's laboratories provides many clues to ways of increasing the life of condenser and heat exchanger tubes in specific applications.

Among the investigations which are carried on are those dealing with the behavior of various metals and alloys when partly or completely immersed in different corrosive media, such as sea water, acids, and alkalis. The data thus obtained, when correlated with information gathered from Bridgeport's comprehensive field experience, are of value not only in the development of new and improved alloys, but also in the recommendation of existing alloys for specific service conditions.

It has been found, for example, that by the addition of a small percentage of an inhibitor to the solution, the corrosive action of an acid such as dilute sulphuric acid can be reduced to such an extent that no attack takes place even at the water line, although the same solution without an inhibitor will in time entirely dissolve certain alloys.

Moreover, the addition of a small percentage of another metal to the alloy may have a profound effect on its resistance to certain types of corrosion. A study of the effect of these additions points the way to the development of new alloys with increased corrosion resistance.

Field Studies Lead to Better Condenser Tube Performance

Cooperation between Metallurgist and Engineer Paves The Way for Increased Operating Efficiency

The extensive field studies made by Bridgeport metallurgists, in cooperation with marine and power plant engineers, are playing an important part in lengthening tube life and in laying the groundwork for improved operating efficiency.

Bridgeport laboratory men are frequently called upon to help solve problems involving premature failure of condensers or heat exchangers. Service conditions, which are not generally the same in two different localities, and often vary even in two similar condensers in the same plant, are responsible for excessive corrosion, resulting in shutdowns and interruptions in the flow of power or vital production.

In many cases, it is possible to select one or another of the existing condenser tube alloys which will best withstand given conditions. However, the subject of corrosion is a complex one, and conditions which influence it are many and variable. For a satisfactory solution, each installation should be treated as a special case.

Study of Service Conditions

When a Bridgeport metallurgist is called in to diagnose early tube failure, his first step is to investigate the nature of the service conditions, discussing with the operating engineer such points as: past experience with the alloy or alloys used; service conditions, including nature of circulating solution, nature of vapors; range of temperatures, pressures, and velocities.

From a consideration of these factors and from an examination of a sample of the corroded tubing, he may in many cases, from his broad experience, be able to recommend an alloy that will give the most satisfactory service. In other instances, where additional data are required, he may recommend testing sample tubes of different alloys under actual service conditions, to determine the best results.

This procedure not only provides an economical means for the engineer to determine the best alloy, but the service data obtained are of great value in assuring increased tube efficiency in future applications. The effectiveness of this method of investigation is indicated by a case history taken from the files at Bridgeport.

A certain company, in cooling alcohol vapors, found that the polluted circulating sea water severely corroded the copper cooling tubes where the vapor temperature was highest. Failure from corrosion occurred after about 3 years' service.

A comparative corrosion test showed very little attack on Duronze IV after 3 years' service. Copper, which was used as a control specimen, failed during the same interval. As a result, Duronze IV tubes were used to replace the copper, and are now in active service.

These field studies carried out in cooperation with Bridgeport metallurgists are of great value to marine and power plant engineers, since they offer an excellent opportunity for the scientific investigation of condensers and heat exchangers, and for obtaining first-hand information on the behavior of the alloys that go into them.

While war restrictions are limiting, for the present, the use of certain strategic materials, studies now going on are paving the way for increased condenser and heat exchanger economy in the postwar era.

Research investigation on tube alloys in Bridgeport's laboratories complements field service studies in providing clues to increased life of condensers and heat exchangers.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

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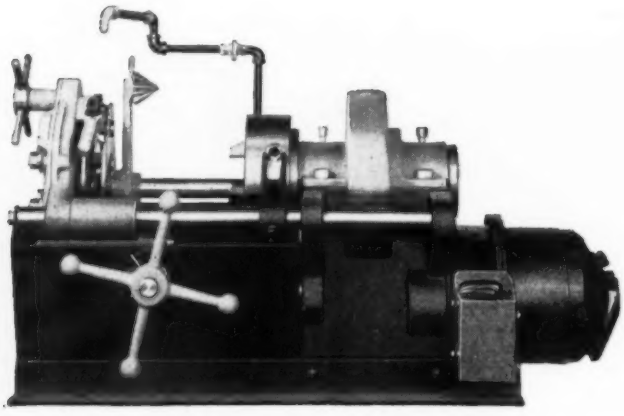
"TOLEDOS" Are Helping To Win The War



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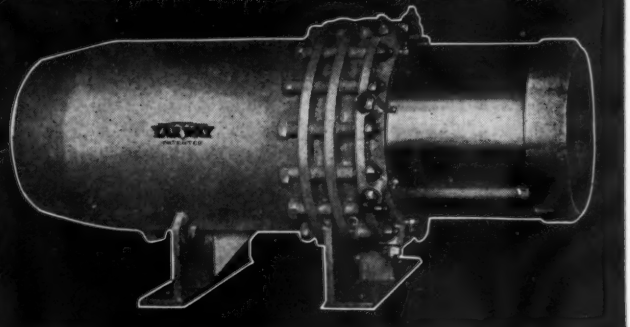

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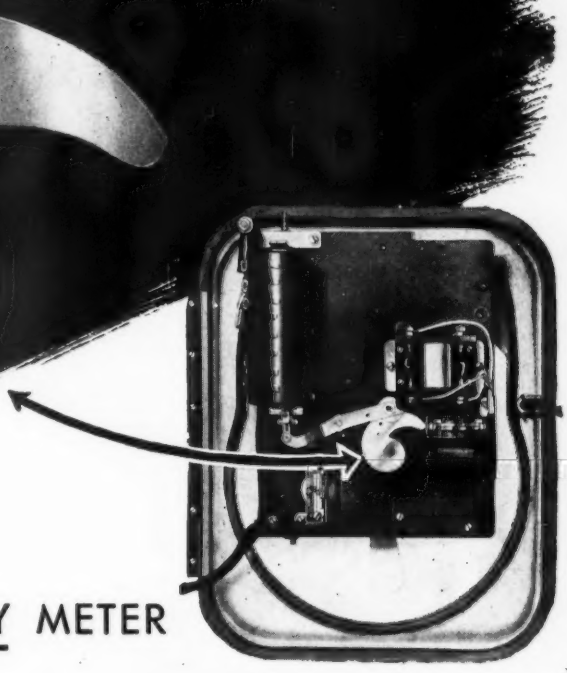
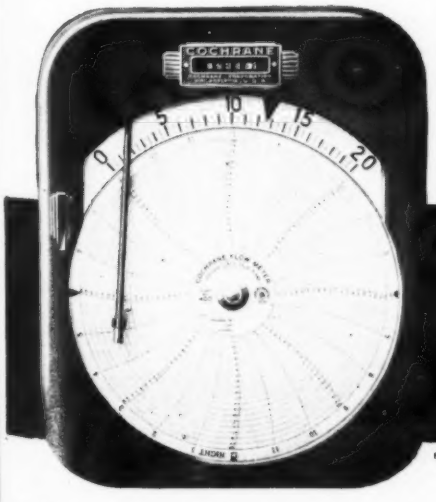
THE COCHRANE FLOW METER CAM



EACH CAM INDIVIDUALLY CALIBRATED—INSURING HAIRLINE ACCURACY IN EVERY METER

A STANDARD CAM is utilized in the Cochrane Flow Meter receiver mechanism. This cam has two important functions. First, it rectifies the square root relation of rate of flow to differential pressure, making possible the uniformly graduated Cochrane chart instead of the misleading square root graduations.

Second, each cam is individually calibrated for each meter at the time the final calibration test is made. This insures unexcelled ACCURACY. There's nothing like it! The individually calibrated cam is just another of the refinements that guard the priceless accuracy of Cochrane Flow Meters. We start with a friction-free transmitter, we relieve the measuring circuit of all work by means of a sensitive galvanometer for detection of difference in rate of flow and we end with high and equal power throughout the entire scale by using an external source of power for indicating, recording and integrating.



To sum up: $\text{ACCURACY} = \frac{\text{POWER}}{\text{friction}}$

In the Cochrane Flow Meter the power comes from an auxiliary motor and not from the measuring circuit, which is relieved of all work. The Cochrane Meter is a true null device.*

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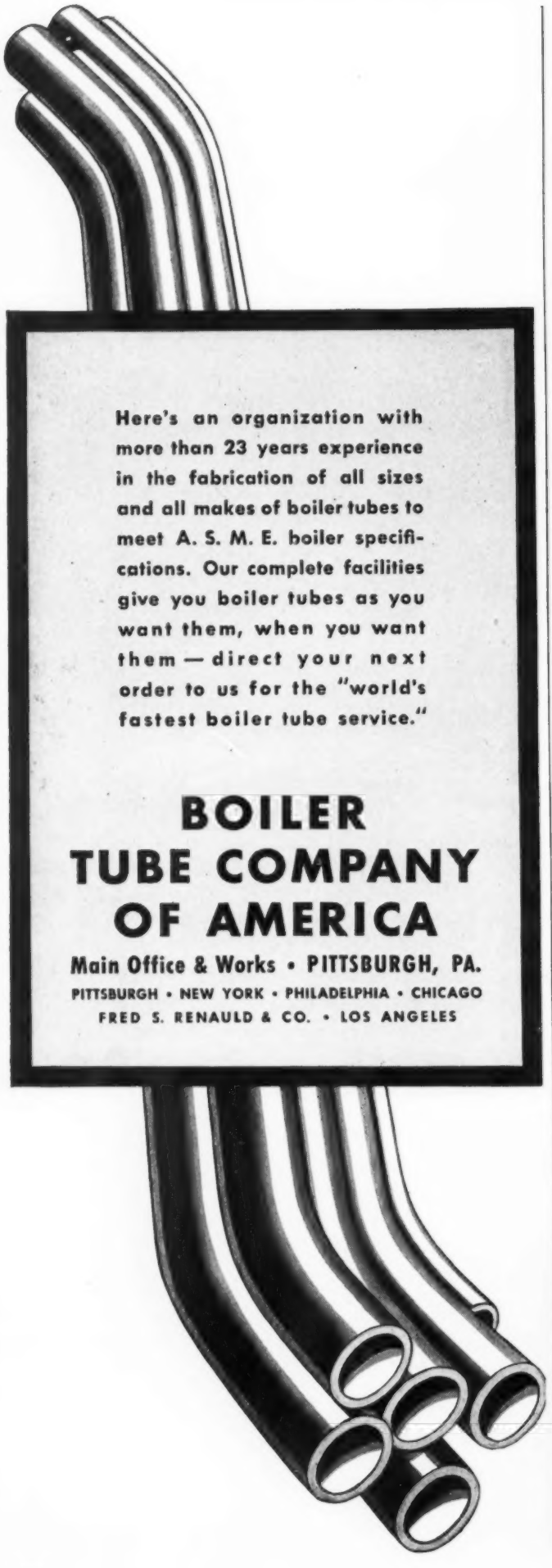
COCHRANE FLOW METERS

**A bridge circuit alone is not a null method meter. A galvanometer is required to detect unbalance, and an external source of power to restore balance.*



Here's an organization with more than 23 years experience in the fabrication of all sizes and all makes of boiler tubes to meet A. S. M. E. boiler specifications. Our complete facilities give you boiler tubes as you want them, when you want them — direct your next order to us for the "world's fastest boiler tube service."

BOILER TUBE COMPANY OF AMERICA

Main Office & Works • PITTSBURGH, PA.

PITTSBURGH • NEW YORK • PHILADELPHIA • CHICAGO

FRED S. RENAULD & CO. • LOS ANGELES

Will it Help Win the War?

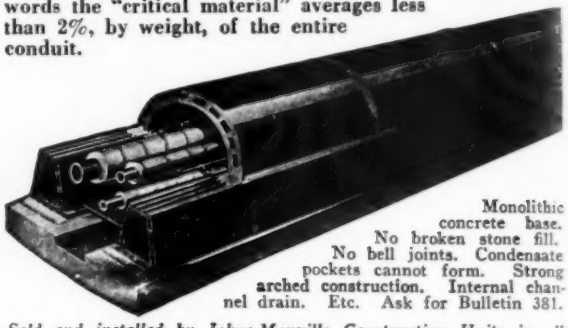
That is the important test for every decision today. When applied to

THERM-O-TILE

Reg. U. S. Pat. Off.

Underground Pipe Conduit

the answer is definitely "Yes" because you SAVE METAL when you use Therm-O-Tile. Pipe saddles and supports require the *only* metal in this conduit. In other words the "critical material" averages less than 2%, by weight, of the entire conduit.



Monolithic concrete base. No broken stone fill. No bell joints. Condensate pockets cannot form. Strong arched construction. Internal channel drain. Etc. Ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.

827P Frelinghuysen Ave., Newark, New Jersey

Without obligating us in any way, ☐ Please send Bulletin 381. ☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Clip your name, firm, and address to this ad; tear out with the checked squares above, mail, and you will hear from us promptly.

FIREBRICK

"Tailor-Made"

Quickly - Accurately

The Modern Way to economical Boiler and Furnace repairs and construction . . . Clipper Masonry Saws cut virtually every kind of Firebrick. "A shorter length or special shape as far away as your Clipper Saw."

Available on TRIAL
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CLIPPER MFG. CO.

1055 So. Vandeventer
St. Louis, Missouri

You Don't Remove a DARLING VALVE from the Line..

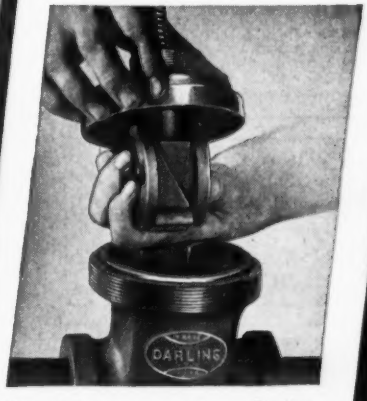
LUCKY BREAK, wasn't it, the day you installed those Darling Double Disc Gate Valves. It means that you don't have to worry about slowing down production to remove worn, leaky, faulty valves from the line. Longer life, tighter seating, better service *are designed into* Darling Valves, with 4 simple parts that have stood up under industry's toughest jobs for years.

When, after long and severe service, the parts should become worn, you don't remove the valve from the line. You simply replace two discs and two wedges—4 inexpensive parts—the entire working assembly of a Darling Double Disc Gate Valve.

It may be diffcult to get Darling Gate Valves today. Most of Darling's output has been enlisted to help float Uncle Sam's ships to victory. Replacement parts are available. New valves will also be available for shipment immediately following government release from present commitments, on or before the time the war is over.

Only 4 PARTS

Two discs and two wedges—the entire working part assembly of a Darling Double Disc Gate Valve. There is no other valve with this design. The seats are parallel. The discs are *fully revolving*, seating in a different position each time the valve is operated. This means tighter seating, less wear, longer operation and lower maintenance costs with Darling Gate Valves.



You don't have to take a Darling Double Disc Gate Valve out of the line to replace the parts. Simply insert new and inexpensive assembly parts and replace Stem and Bonnet. Valve is again ready for long, hard service.

TRADE DARLING MARK

VALVE & MANUFACTURING CO.

WILLIAMSPORT, PA.

WHERE TO BUY

Featuring additional products and specialties for power plants

Army and Navy Transports, Coast Guard ships, Maritime Commission vessels, and many important *manufacturing* and *metallurgical* plants use Armor-Clad Furnace Coatings to substantially increase the life of furnace refractory linings and prevent *untimely* furnace wall failures, *no matter how stringent the service.*

Full protection is provided for *Arches, Jambs, Baffles, Impinged Areas,* etc.

Armor-Clad coatings *cannot* and *do not* spall from refractories, are low priced and easily applied.

Send for Bulletin "Keep America's Furnaces on the Firing Line", also free samples of various type coatings.

ARMOR-CLAD COMPANY
39 Hyatt Ave., Newark, N. J.
Emil A. Schroth, Pres.

CHIMNEYS
Industrial Waste Burners
AMERICAN CHIMNEY CORP.
141 Fourth Ave.
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USE LESS FUEL GET MORE POWER

FIRE TUBE MODEL SHOWN
VIBRATAP CLEANER
● For fire tube and water tube boilers. Rapid vibration quickly breaks scale's grip on tubes. Fast, perfect cleaning—down goes fuel expense! Just try one! Also ask about our Mohawk power-driven Soot Scraper.
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Tripp Metallic Packing
TRIPP METALLIC PACKING CO.
BOSTON MASS.

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BOILER BAFFLES
HIGH TEMPERATURE
Refractory Cements
SANFORD C. SMITH REFRACTORIES, INC.
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Detecting wastes in Electricity, Gas, Fuel and Water, thus stopping losses, and frequently increasing production — nominal fee.
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Engineers and Consultants on Water Conditioning Problems
Surveys . . . Plant Studies . . . Analyses
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THE J. G. WHITE ENGINEERING CORPORATION
ENGINEERS—CONSTRUCTORS
New York, N. Y.

Ask oil refiners about B&W tube life

The men who make 100-octane aviation fuel, butadiene and toluene, need tubes that will stand up to temperatures higher than you'll find in any boiler — and to corrosive crudes that would make the poorest feedwater seem mild. For years, The Babcock & Wilcox Tube Co. has been an outstanding supplier of seamless steel refinery tubing, because B&W developed in unsurpassed degree the technique of specialty-tube manufacture along with special alloy steels for the oil refining industry.

Your B&W Seamless Steel Boiler Tubes are made by the same men who make B&W Refinery Tubes — in the same mill — by the same methods — with the same exacting care.

Particularly in these times, when an unexpected shutdown for re-tubing can be calamitous, it is important to secure the extra quality inherent in all B&W Seamless Boiler Tubes.

BABCOCK & WILCOX TUBES

HOT FINISHED ALLOY STEELS
COLD DRAWN CARBON STEELS

THE BABCOCK & WILCOX TUBE COMPANY
BEAVER FALLS, PA.

TA-1219

★

Demanded Wages vs. Earned Wages

Every man who must manage other men and women must sooner or later face the question of what attitude to take on a wage problem.

Most management men, today firmly believe that the higher the standard of living, the greater the opportunities for themselves and their business.

However, few people realize the difference between a true increase in living standards and a flat demand for higher wages.

The management man is often forced to resist a wage increase which he knows will handicap his plant, or his entire industry, and therefore, its ability to provide employment.

In meeting demands for wage increases which are not justified by more efficient operation, management seldom has the opportunity to defend its attitude toward real wages, based upon increased efficiency. If management does attempt an explanation, its arguments are often discounted.

To help give both public and government a clearer understanding of the difference between a demanded wage and an earned wage, McGraw-Hill has published the advertisement reproduced here, in Washington, New York and Chicago newspapers.

I hope you will read this entire newspaper advertisement carefully. Then, I will appreciate it if you will write me and let me have your comments. If you want reprints for your friends, I'll be glad to see that they are supplied.

James H. McGraw, Jr.

President

McGraw-Hill Publishing Company, Inc.

This
NEWSPAPER
advertisement was published in Washington, New York and Chicago by McGraw-Hill, to make friends for business.

Where do WAGE INCREASES *come from?*

In these days, when words like "economics" and "collective bargaining" help to obscure plain thinking on such old-fashioned problems as *earning a living* and *asking for a raise*, it is sometimes hard to remember that, underneath the chromium plate of words, things work out pretty much the same as they always have.

In the old days, every plant and mine was on its own. Economics was visible to the naked eye. You kept your costs in line with competition, or you took immediate consequences in reduced sales and employment. Today, if wages are increased through national wage agreements, costs go up in an entire industry.

► To many people that seems an improvement on the old-fashioned way, and few stop to ask where the catch is.

The simple fact is that new words cannot repeal arithmetic. National wage increases, like local wage increases, must be paid for either through higher prices or through lower costs, resulting from better equipment and more efficient methods.

Waiting down the road for the higher-priced industry is the same fellow who used to keep the single plants in line . . . THE BUYER.

This advertisement is available in handy booklet form. (Less than 100 copies free. Larger quantities, $1.50 per 100; $10.00 per 1000).

Where do wage increases come from? (cont'd)

The consumer always corrects high prices in the long run. Just as the high-priced individual plant lost business in simpler days, so the high-priced industry loses business today.

If coal, for instance, gets too high-priced in war, buyers will turn to other sources of heat and energy when they have the opportunity.

► This will happen in the case of a customer here and a customer there, but the total will pile up until the miners find themselves with high hourly wages, but without enough market for their product to keep them steadily employed.

This has happened before, where men have tried to lift themselves by a strong pull on their political bootstraps.

How can people live better?

It ought to be clear to Americans, of all people on earth, that better living comes only through doing things better.

It does no good to have more dollars in the pay envelope, if those dollars are going to raise prices. Higher prices make buyers look for a substitute for the things you produce. If the things you make don't sell, you live poorer, no matter what your hourly rate of pay.

That made sense when we were a little country. Doesn't it still make sense?

► Let's take coal, again, as an example. People can pay more for coal (thus allowing more for real wages) every time somebody invents a way to make each ton of coal produce more heat. The energy is in the coal. All we need for better living for coal miners is constant improvement in machines for getting heat out of coal.

—OR, miners can earn higher wages at the same price for coal every time somebody invents a machine for getting out *more coal per miner*.

Those two things—a better product, or the same product for less money—have been the secret of our better living. They always will be the secret. Any wages that are increased without them are a burden on every buyer.

In mining, as in all industry, the only way to get better living is to continue to use the old-fashioned recipe that has made America great.

Here is the recipe for better living, in mining and in all industry:

1. Constantly improve the equipment available for the worker.
2. Use the lowered costs thus produced to
   (a) lower prices to consumers
   (b) raise wages
   (c) provide incentives for invention, leadership and investment
   (d) lay aside "Seed Money" that can be used to start over again at item 1.

"Seed-Money" produces better living

America has always been an inventor nation. Throughout the years, most of the profits of business have been used to buy inventions . . . better machines, more efficient factories, research for better products. We call profit that is "plowed back" into business "Seed Money." Through Seed Money, products are constantly improved, making possible lower prices and higher wages.

Did you know that this process of putting aside Seed Money has been almost entirely eliminated by our tax law?

► Congress, in properly shutting the door on wartime profiteers, wrote the Excess Profits Law in such a manner that it also takes away most of the Seed Money of business.

Industry must have Seed Money to continue the work of making better products available at lower costs, to create more jobs and pay higher *real* wages. The Excess Profits Law must be changed if we are to provide Seed Money for making post-war jobs. If you think so, too, ask your Congressman to review this law and all laws —with this principle in mind:

"Industrial Progress is the Basis of all Good Living".

THE McGRAW-HILL NETWORK
OF INDUSTRIAL COMMUNICATION

22 publications, which gather "war-news" from the "war-production-front" through a staff of 153 editors and 725 engineer-correspondents . . . More than 1,500,000 executives, designers, production men and distributors use the editorial and advertising pages of these magazines to exchange ideas on war-production problems.

McGRAW-HILL BOOKS

Publishers of technical, engineering and business books for colleges, schools, and for business and industrial use.

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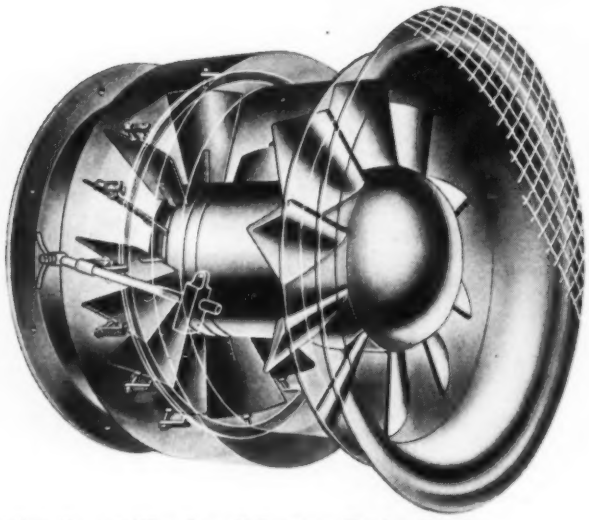
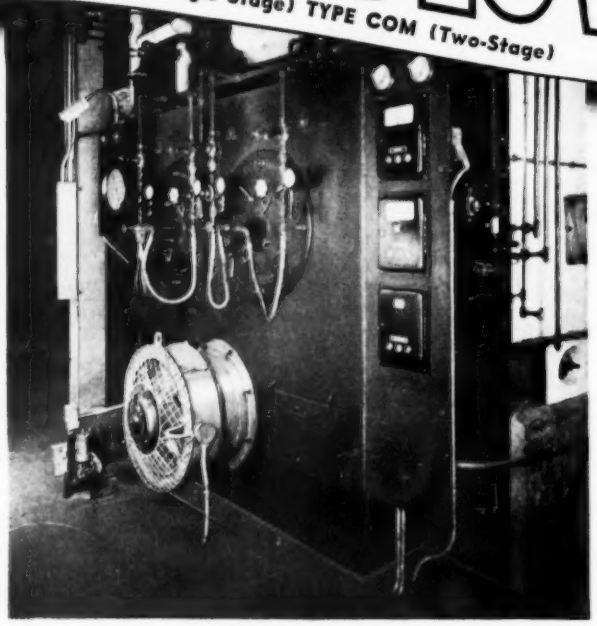


Phantom View of Wing Type EMD Blower Showing Voltrol-Vanes and Axial Flow Fan

External View of Wing Type EMD Blower From Intake End

WING AXIAL FLOW BLOWERS

TYPE EMD (Single Stage) TYPE COM (Two-Stage)



A compact efficient installation in plant of large tool manufacturer

HIGH EFFICIENCY

Total Head Efficiencies Run 90% and higher

NON-OVERLOADING HP CHARACTERISTICS

•

CAPACITY REGULATION BY BUILT-IN VOLUME CONTROL

(Wing Voltrol-Vanes)

Internal radial dampers are actuated by an external balanced lever. This can be adjusted manually or connected to any standard combustion control regulation. It is precise in action and a reduction of volume is accompanied by reduction of horsepower over a wide range.

GREAT COMPACTNESS

and Weight Economy of Space

EASE OF CONTROL

QUIET OPERATION

•

SIMPLICITY AND RELIABILITY

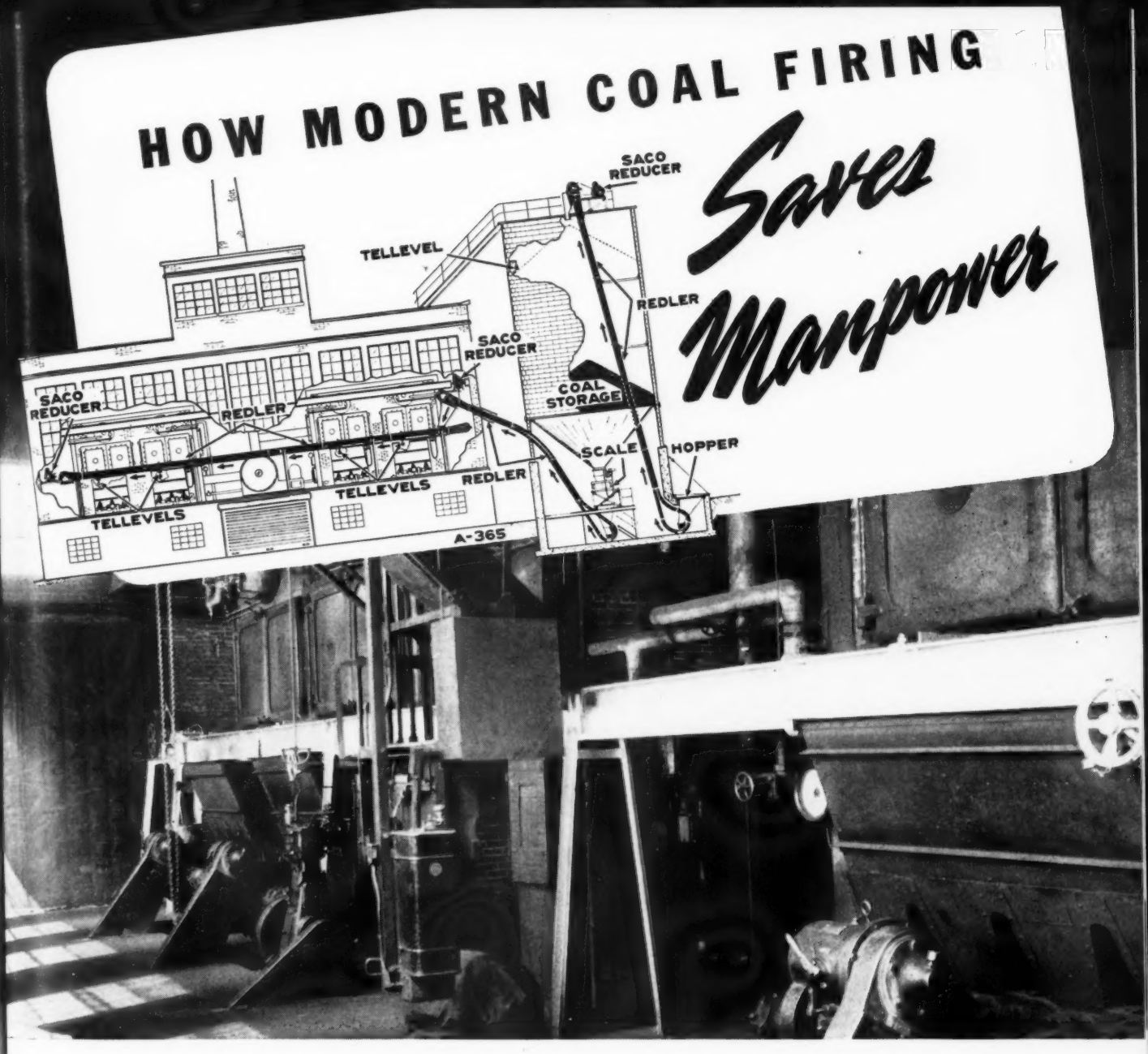
All mechanical features are of simple design and rugged construction. Motors are fully enclosed, dust proof, and constant speed. Fans are mounted directly on motor shafts. Entire assembly is sturdily supported inside the cylindrical casing. Heavy screen protects inlet. Discharge is flanged for ease of connection.

L. J. WING MFG. CO.

West 14th St., & 7th Ave., New York, N. Y.

Factories: Newark, N. J.

HOW MODERN COAL FIRING *Saves Manpower*



Stephens-Adamson REDLER Conveyors

• Modern methods of coal handling—from car to boiler—make solid fuel as practical and convenient as other forms.

As shown above S-A Redler Conveyor-Elevator installations are almost as simple as stringing a wire—and coal flows through their compact dust-tight casings just about as smoothly and efficiently. There are no complicated accessories—just casings, skeleton conveying element and low speed drive mechanism. (Notice the S-A Saco Reducers as used above.)

S-A offers you *all* designs of coal and ash handling equipment and systems, including standard Belt Conveyors and Bucket Elevators—Pivoted Bucket or Gravity Discharge Conveyors—as well as the patented Redler Conveyor-Elevator. Our engineers will, without obligation, be glad to consult with you at your convenience.

WRITE US

STEPHEN S-A ADAMSON MFG. CO.

Chains and Sprockets · Belt Conveyors · Bucket Elevators · Crushers
Bin Gates · Pan Conveyors · SealMaster · Feeders · Screens
Speed Reducers · Redler Conveyors · Ball Bearings · Skip-Hoists · Winches and Car Pullers

5 Ridgeway Avenue, Aurora, Illinois

How to obtain "ALL-OUT" WATER SAVINGS from flush valves

CONSERVE FUEL AND POWER FOR THE WAR EFFORT!

FLUSH VALVES save water compared with any other type of flushing equipment. That's one of the big reasons why they are so widely used today.

Not always appreciated, however, is the fact that SOME flush valves save a great deal MORE water than others.

The Secret of Water Saving

The secret of obtaining MAXIMUM water savings from flush valves is to have the length of flush of each valve ADJUSTED to the actual water needs of the fixture on which it is installed. Fixtures vary in their water requirements and frequently as much as a gallon or more of water per flush can be saved by proper adjustment.

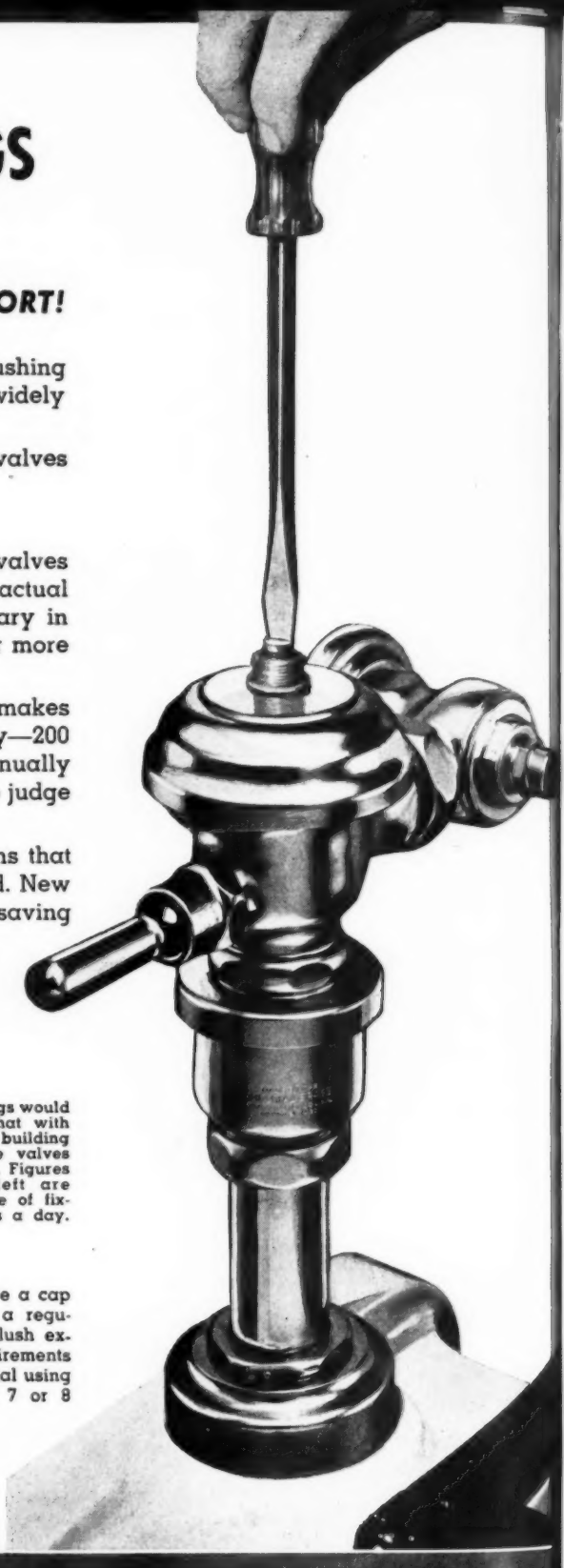
The tremendous EXTRA savings which individual adjustment makes possible can be judged by the fact that in a building with say—200 flush valves, an additional water saving of 1,168,000 gallons annually might be expected on the basis of one gallon saved per flush. (To judge what may be saved in other buildings, see table following).

Water saved not only means lower water bills, but also means that fuel and power—required for pumping the water—are conserved. New service manual described below will give you full data on saving with flush valves. We'll be glad to send you a copy.

Estimated annual savings of water obtainable through proper regulation of flush valve to actual water needs of fixture*

	Building with 100 Flush Valves Gallons saved	Building with 500 Flush Valves Gallons saved	Project with 1000 Flush Valves Gallons saved
When average of ½ gal. saved per flush	292,000	1,460,000	2,920,000
When average of 1 gal. saved per flush	584,000	2,920,000	5,840,000

*These savings would vary somewhat with the type of building in which the valves are installed. Figures shown at left are based on use of fixture 16 times a day.



Every Watrous Flush Valve Is Adjustable

When you install Watrous Flush Valves you make possible ALL OUT water savings on every job because EVERY Watrous Flush Valve is READILY ADJUSTable. It is not necessary to take the valve apart or even to shut off the water.

All that is required is to remove a cap nut and then a partial turn of a regulating screw sets the length of flush exactly in accordance with the requirements of the fixture—whether it is a urinal using ½ gallon or a closet requiring 7 or 8 gallons per flush.

KNOW MORE ABOUT FLUSH VALVES

Anyone who has any interest in the specifying, installation or maintenance of flush valves should have the information contained in the new service manual —"Keep 'Em Flushing"—just published by Imperial Brass.

With simple diagrams it shows how a flush valve operates. Gives full data on how to obtain maximum water savings; shows how to reduce maintenance time to a minimum. Includes a helpful "trouble-shooter" chart; other data.

Write for your copy

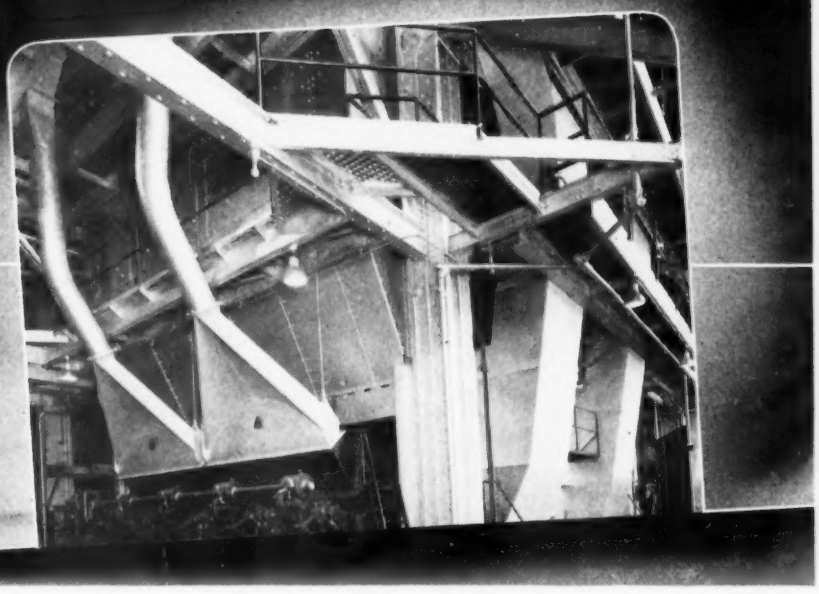
ESPECIALLY VALUABLE at Army, Navy and Air bases

THE IMPERIAL BRASS MFG. CO.
514 South Racine Ave. Chicago, Ill.
Distributed through wholesalers of plumbing materials

Watrous Flush Valves

DIAPHRAGM and PISTON TYPES . . . also furnished with SILENT-ACTION equipment

Why Specify CONICAL Non-Segregating Coal Distributors?



• CONICAL Non-Segregating Coal Distributors are the only stationary means of putting coal into stoker hoppers without segregation. Better firing conditions result—higher average CO_2—lower combustible in the ash — higher ratings—lower maintenance. Write today for illustrated catalogs showing CONICAL Non-Segregating Coal Distributors and complete "Bunker to Stoker" and "Bunker to Pulverizer" installations by S. E. Co. Address Stock Engineering Company, 9807 Theodore Avenue, Cleveland, Ohio.

CONICAL Non-Segregating Coal Distributors

STOCK
ENGINEERING CO.

S. E. Co. Coal Valves and Coal Scales

MODEL 25D

ELIMINATE THE HUMAN ELEMENT!

Put MANZEL LUBRICATORS on Your HEAVY MACHINERY

Don't risk a breakdown in your wartime production by trusting to obsolete, rule of thumb methods of oiling. Manzel Automatic Force Feed Lubricators insure steady, day after day operation of machinery because they deliver exactly the right amount of oil at exactly the right time.

Manzels are protecting bearings and cylinders of engines, pumps, compressors and all types of heavy machinery in every phase of our War Effort. They never forget. And all they ask of the operator is to keep their oil reservoirs filled. For nearly 50 years the name "MANZEL" has stood for dependable, trouble-free lubrication.

ASK FOR CATALOG 25-C

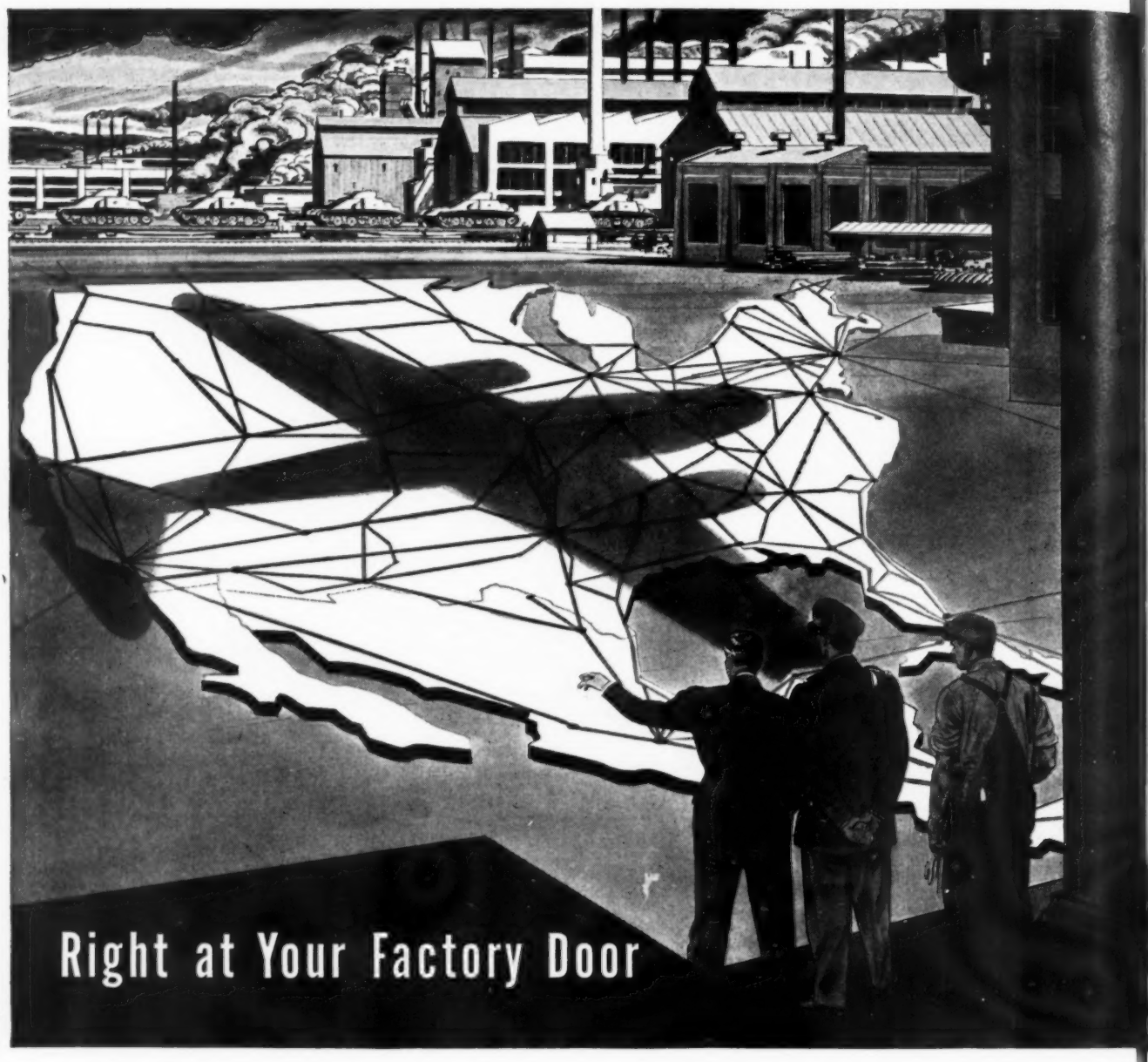
MANZEL BROTHERS COMPANY **326 Babcock St., Buffalo, N. Y.**

BROWNELL STOKERS

For those interested in a *good* stoker for plant, institution, office building, hotel, apartment or home, there's a Brownell Underfeed to suit your requirements up to 500 h.p. with single retort—larger industrial sizes with twin retorts.

Write for illustrated bulletin

THE BROWNELL COMPANY — The World Over — SINCE 1855 — DAYTON, OHIO, U.S.A.



WHEN the Japs struck at Pearl Harbor, the Air Express system of the United States was by far the greatest in the world.

Built during years of peace, it required no conversion for war. It was *ready to go!*

Now, as then, Air Express provides industry with a vast network of skyways over which to move critical material at a speed of three miles a minute.

For the manufacturer, it's almost like having the entire nation right at his factory door—no supplier or sub-contractor can be far away with this fastest form of delivery.

It serves every U. S. industrial town and city, and more than 60 foreign countries —either direct or by rapid Air-Rail connections, with schedules that are figured in hours instead of days and weeks.

It gains millions of work-hours for thousands of war plants, with vital shipments that prevent production tie-ups, break industrial bottlenecks and keep men on the job.

TODAY, Air Express also works hand in hand with the Army and Navy Air Transport services, to supply our fighting fronts throughout the world.

TOMORROW, Air Express will girdle the globe in friendly commerce, and will bring *all* foreign markets to the doorstep of American business.

AIR EXPRESS SPEEDS WAR PRODUCTION

SHIP EARLY — as soon as shipment is ready — to assure *fastest* delivery. PACK COMPACTLY — to conserve valuable space. ASK for our "War-time Wall Chart"—an illustrated guide for simplified preparation of Air Express shipments.

AIR EXPRESS

Gets there FIRST

Phone RAILWAY EXPRESS AGENCY, AIR EXPRESS DIVISION • Representing the AIRLINES of the United States

Behind the War Production Front . . .

HIGH TEMPERATURE—HIGH PRESSURE

FABRICATED PIPING SYSTEMS
for SAFE POWER DELIVERY

A tremendous output of power is required to produce the enormous quantities of war equipment so urgently needed today. To harness this tremendous output of power and turn it into proper channels of economic usefulness on the production front, necessitates High Temperature, High Pressure Piping. The fabrication of this piping into compact, efficient piping systems, with speed and precision is *our job.*

Pittsburgh Piping & Equipment Company's forty years of successful experience in scientific research, engineering and development in the fabrication of single units or complete piping systems is your assurance of obtaining the best in design, equipment and *service.*

Complete facilities for bending, welding, machining, heat treating, stress-relieving . . . experienced personnel for designing, fabricating and erecting . . . a well equipped metallurgical laboratory to constantly check materials and operations . . . assure accuracy, quality, dependability.

Have your engineer consult our nearest representative on your piping requirements. There is no obligation.

PITTSBURGH PIPING & EQUIPMENT CO., 10 FORTY-THIRD ST., PITTSBURGH, PA.

Woolworth Building, New York • • Occidental Building, Indianapolis • • Peoples Gas Building, Chicago Book Tower, Detroit
Public Square Building, Cleveland • • 10 High Street, Boston • • 525 Market Street, San Francisco

ABUNDANT POWER

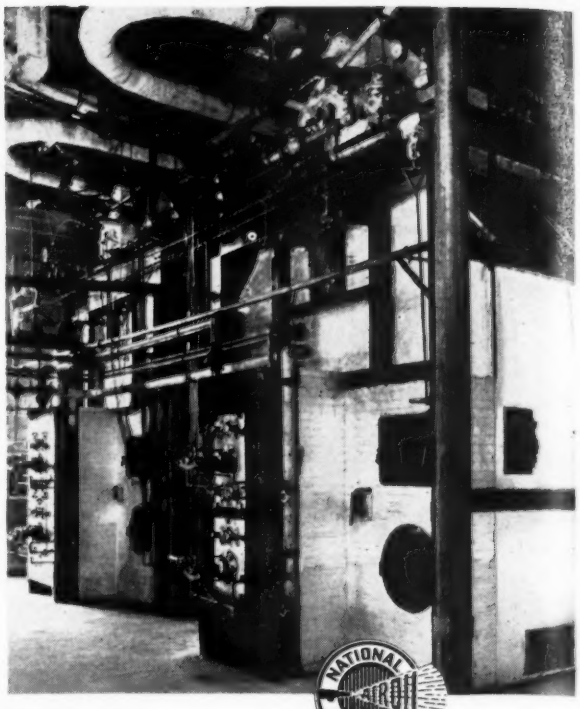
...at your price for fuel..:.with

National Airoil Burners

Even the cheapest grade of oil and tar are completely atomized by our Type SA Burners, which operate continuously without clogging or cleaning, and help create a symmetrical, easily-regulated flame in which the fuel mixture is completely consumed.

Type SAL Oil and Residuum Burners can efficiently and safely burn pitches and asphalts in installations where the temperature of the fuel is as high as 700° F.

We'll be glad to suggest the best burner for your use—absolutely without obligation!



Large Canadian refinery equipped with National Airoil high capacity Burners

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OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS
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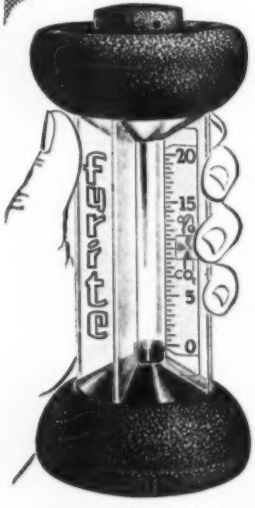
FUEL CONSERVATION BEGINS IN YOUR BOILER ROOM

USE THE PORTABLE

FYRITE CO_2 ANALYZER



To Reveal Fuel Waste INSTANTLY!

The first step towards fuel economy is to control chimney losses. The FYRITE "Orsat" CO_2 Analyzer makes accurate flue gas tests easy—instantly exposing fuel wasted up the stack. The FYRITE is conveniently held in the hand while analysis is taken. It is accurate within ½ of 1% CO_2; spill-proof; cold-proof; rugged, durable, compact. More than 7000 in use.

RETURN COUPON BELOW. *Obtain new bulletin on FYRITE and learn how to get immediate delivery under priority regulations.*

$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

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Pulsating Electromagnet

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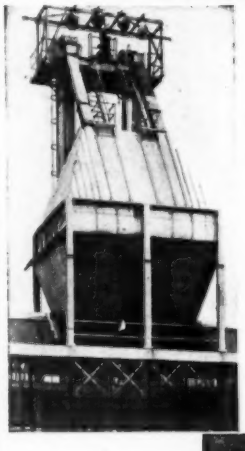
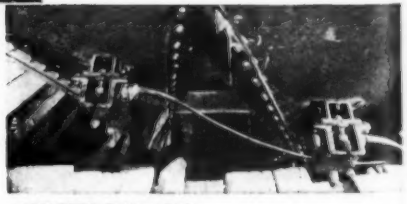


on Coal Bunkers, Chutes, Bins, Stoker Hoppers, etc.—will prevent "Constipation"—Keep stubborn materials, such as damp, sticky coal free-flowing at all times.

Adjustable power by rheostat control.

8 different models—ranging from a little 4 lb. model up to a big 500 lb. model for large bunkers.

A NEW CATALOG No. 433 IS NOW AVAILABLE



SYNTRON CO.
492 Lexington Ave. Homer City, Pa.

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WATCH ENGINEER Experienced, capable, sober and reliable man for steam turbine electric plant in a City of the South. High school graduate, or better, preferred. Drifters and seekers for high wartime pay rates need not apply. If you are looking for a normal position, at good rates, give names of references, age, family situation, draft classification, education and full outline of experience in first letter. References will not be contacted until your permission is given. P-522, Power, 520 N. Michigan Ave., Chicago, Ill.

WANTED—Mechanical Engineer for design, drafting and construction supervision. Furnish complete personal details. P-523, Power, 330 W. 42nd St., New York, N. Y.

PROGRESSIVE, well-known manufacturer of pumping equipment has an opening for an experienced sales or application engineer, preferably one whose experience covers centrifugal, rotary, and turbine type pumps. The position to be filled results from expansion which is part of a long-range program and is not a short-term or war-time proposition. All replies will be considered strictly confidential. P-524, Power, 520 N. Michigan Ave., Chicago, Ill.

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SALARIED POSITIONS — $2,500 to $25,000. This advertisement service of 33 years' recognized standing negotiates for positions of calibre indicated. Procedure individualized to your personal requirements. Retaining fee protected by refund provision. Identity covered. If salary has been $2,500 or more send for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo, N. Y.

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ENGINEER—Experience includes responsible charge of design, construction and operation for power generation; transmission and distribution for large industrial plants; with associated hydroelectric and steam plants. Presently employed on work nearing completion. Not subject to draft. Licensed professional engineer. PW-525, Power, 330 W. 42nd St., New York, N. Y

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An Internationally established line of Separatory Equipment for steam, air and gas, has a few select territories open. Liberal commission. Territories open, Western Pennsylvania, Middle States and Great Lakes area.

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POWER PLANT ENGINEER

Municipal Power Plant in Ohio requires the temporary services of an experienced Power Plant Engineer to set up a system of Power Plant Management and train present personnel in the efficient operation of a modern power station.

Plant consists of stoker and pulverized coal fired boilers. Applicant must be a good combustion man, familiar with latest automatic control, and modern feed water treatment, Turbo-Generator, and condensing equipment.

A new addition to the plant is now 75% complete.

State salary expected, and when available.

All replies will be acknowledged and held in strict confidence.

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Experienced man to operate Westinghouse Bleeder Type Turbine and Auxiliaries in Paper Mill. Must be sober and reliable. Good opportunity for the right man.

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OPERATING ENGINEERS—WANTED

Operating engineers who have or have had a Marine Engineers' License. Wages from $300 to $700 per month.

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* MECHANICAL ENGINEERING *

Also furnishing power plants, industrial, municipal and private, plants, designed, appraised or built, complete or parts, steam or other fuels, boilers, engines, pumps, machines and manufacturing plants also, new or used equipment.

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WANTED BOILERS

150—250 HP, HRT, 150# pressure
250—500 HP or larger, 200#

FOR SALE

Six 500—350 HP straight tube 175#
150 HP—35 HP Scotch Marine 125#
25 HP semi Diesel engine

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FOR SALE—

TWO 450 H.P.

HIGH PRESSURE BOILERS

Located at Dayton Ohio

B. & W. STERLING Water Tube Type. Has 418, 3½" Tubes. Formerly Used at the Dayton Ohio Garbage Reduction Plant. These Boilers are in Good Condition and Were Recently Inspected and Passed by the Ohio Boiler Inspector and Approved for 135 lbs. Pressure. They were Built for Use with Stokers but the Stokers were Sold and Removed.

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FOR IMMEDIATE DELIVERY

TRANSFORMERS

3—37½ kva. G.E. Transformers, 11,500/460—230 volt. Bought new 1942.
3—250 kva. G.E. Transformers, 11,500/460 volt. Bought new 1942.

MOTORS

(All 440 volt, 3-phase, 60-cycle)

1—100 hp. G. E.; late type with starting equipment.
1—30 hp. Allis Chalmers ball bearing; 900 rpm. Serial No. 420C-328-8304-4.
5—25 hp. G.E. Splash Proof; 1200 rpm., Serial Numbers 5447970, etc. Model 12F2738. Type KF. Frame 405.
1—25 hp. G. E.; 1200 rpm., Serial No. 5413711. Model 8KF405HC1. Type KF. Frame 405.
1—15 hp. G.E.; 720 rpm., Serial No. 518718.
1—10 hp. Westinghouse; 1800 rpm., Serial No. 8067851.
1—7½ hp. Crocker Wheeler; 900 rpm., Serial No. 213667.
1—7½ hp. Century; 1800 rpm., Serial No. 398449.

Miscellaneous disconnect and magnetic switches.

MACHINERY AND EQUIPMENT COMPANY
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San Francisco, — California

Wanted-NEW INVENTIONS and IMPROVEMENTS

A well established and favorably known plant with long experience in, and extensive special equipment for, the precision manufacture of high-speed rotating machinery seeks new inventions and improvements for production after the war. If a patent or published description of your device is available, send a copy; but if not, indicate only its purpose or field and advantages. If the idea seems to have possibilities, further arrangments can then be made. Address

BO-518, Power, 330 West 42 St., New York, N. Y.

STEEL TANKS FOR SALE

220,000 Gal. Cap. 43 Ft. Dia. 20 Ft. High Riveted Construction.
3—12,000 Gal. & 1—6500 Gal. R.R. Car Tanks.

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400 H. P. INGERSOLL-RAND

Full Diesel Engine 6 Cylinder, 4 cycle, 300 RPM, with Falk 3 to 1 reduction gear and reverse clutch.

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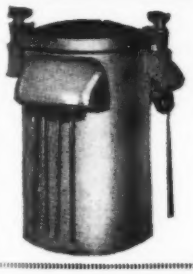
Main 4-3804-5

-TRANSFORMERS-



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in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
We will be pleased to quote prices on request.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M — Since 1912 — CINCINNATI, OHIO

MOTOR REWINDS?

ARE YOU PARTICULAR?
DO YOU HAVE A SPECIAL MOTOR?
We stock only the Best of Insulation
100% Factory Work
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Previous Experience with
General Electric — Allis Chalmers
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FIRST AID TO THE PLANT THAT NEEDS POWER FOR PRODUCTION!

MOTORS GENERATOR SETS

1—35 KW, 125 volt, Electric Machinery squirrel cage induction motor.
1—20 KW, 600 volt, General Electric squirrel cage induction motor.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volts, Allis Chal.

MOTORS—3 PHASE 60 CYCLE

1—720 HP, 360 RPM, 440 volt, G.E., syn.
1—500 HP, 1200 RPM, 440 volt, GE, syn.
1—400 HP, 514 RPM, 440 volt, Westg, slip ring.
1—335 HP, 600 RPM, 2300 volt, GE, syn.
1—300 HP, 720 RPM, 2200 volt, G.E., Sl. Rg.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., Sync.
1—200 HP, 900 RPM, 440 volt, Westg., sl. rg.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 2300 volt, Al. Ch. sq. cg.
1—150 HP, 900 RPM, 440 volt, Al. Ch. sl. rg.
1—150 HP, 720 RPM, 440 volt, G.E., slip ring.
1—150 HP, 600 RPM, 440 volt, G.E., slip ring.
1—150 HP, 400 RPM, 440 volt, G.E., sq. cg.
3—125 HP, 720 RPM, 440 volt, G.E., slip ring.
1—100 HP, 900 RPM, 440, Westinghouse, sq. cg.
1—100 HP, 900 RPM, 440 volt, G.E., slip ring.
3—100 HP, 720 RPM, 440 volt, G.E., slip ring.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., slip ring.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.
2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, 400 RPM, 550 volt, Cr. Whlr, sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1—75 HP, 900 RPM, 220 volt, Fairbanks, Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, GE, sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse, slip ring.
1—75 HP, 720 RPM, 440 volt, GE, sq. cg.
1—50 HP, 900 RPM, 440 volt, GE, slip ring.
1—50 HP, 900 RPM, 440 volt, GE, sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL, Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westinghouse, 550 RPM, Type SK.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM,G.E., type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westinghouse, type SK.
1—50 HP, 700 RPM, Crocker Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 300 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—25 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E. 625 RPM, Type C.
1—25 HP, Westinghouse, 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-12, Form A.
2—20 HP, Westinghouse, 1700 RPM, Type SK.
1—15 HP, G.E., 800 RPM, Type RC-11.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—250 KVA, Westinghouse, 5500/440 volts.
1—200 KVA, Pittsburgh, 7800-110/220 volts.
3—150 KVA, G.E., 33,000 2300/4000 Y.
1—150 KVA, G.E., 2400-120/240 volts.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
1—100 KVA, G.E., 2200-110/220 volts.
3—100 KVA, Westinghouse, 13200 250 volts.
3—75 KVA, G.E., 13,500-7500/440 volts.
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
1—75 KVA, Pittsburgh, 7600-110/220 volts.
3—50 KVA, Wagner, 4150-220 volts.
2—50 KVA, Pbgh. 7500/15,000 volts-110/220 volts.
4—37½ KVA, 2200-220/110 v.
7—25 KVA, Westg., air cooled, 440/220-110 v.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

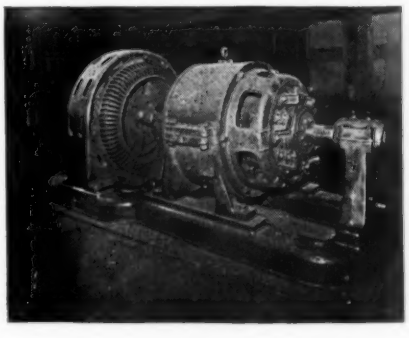
2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—60 HP, 600/1200 RPM, General Electric.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.

ENGINE GENERATOR SETS

1—150 KVA, Generator, Ames uniflow engine.
1—62½ KVA, Westinghouse generator Fairbanks Company Steam engine.



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ELECTRICAL POWER EQUIPMENT

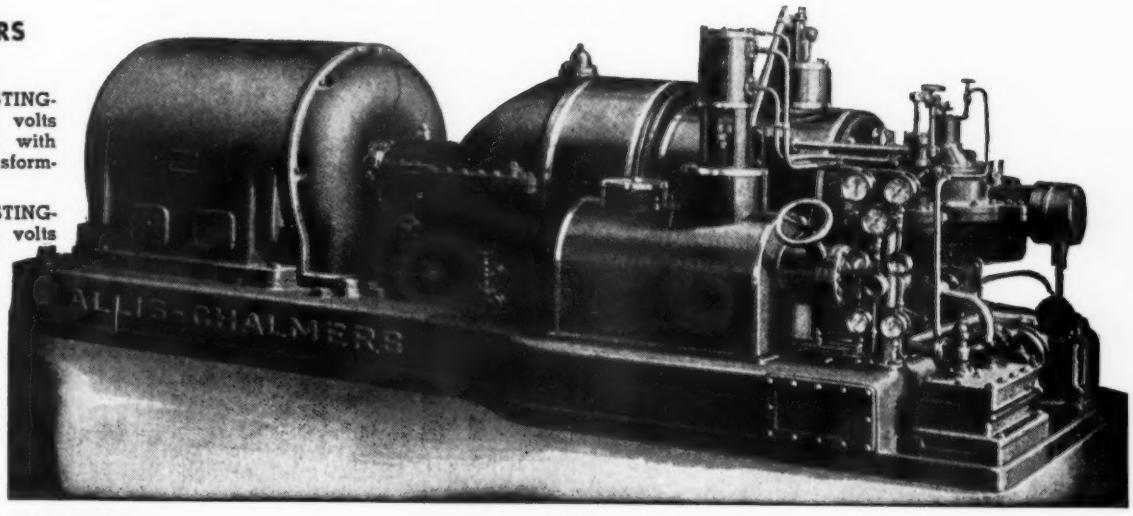
ROTARY CONVERTERS

3 Phase 60 Cycle

3500 KW (2) WESTINGHOUSE, 225-285 volts D.C., 225 RPM with 13200 volt transformers.

1500 KW WESTINGHOUSE, 225-285 volts D.C., 450 RPM with 2300/4000-6900/12000 volt transformers.

750 KW GENERAL ELECTRIC, 600 volts D.C., 1200 RPM with 2300/4000 volt transformers.



Actual Photograph

ROTARY CONVERTER

3 Phase 25 Cycle

1500 KW WESTINGHOUSE, 600 volts D.C., 500 RPM with 3 phase 25 cycle 11000 volt transformers.

SURFACE CONDENSER

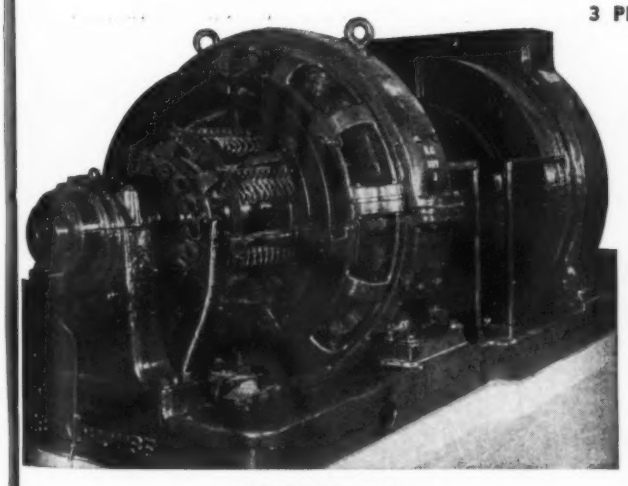
1540 sq. ft. WORTHINGTON surface condenser with steam jet air pumps.

1250 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

MOTOR GENERATOR SETS

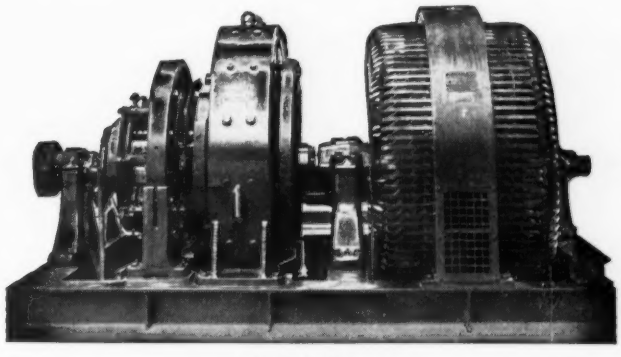
3 Phase 60 Cycle



Actual Photograph

1000 KW WESTINGHOUSE MOTOR GENERATOR SET

1000 KW (1500 KW 2 hrs., 55 deg. C rise) WESTINGHOUSE direct current generator 125/250 volts 3-wire 720 RPM direct connected to 1427 HP 80% P.F. (2140 HP 2 hrs. 55 deg. C rise) WESTINGHOUSE synchronous motor 3 phase 60 cycle 2300 volts 720 RPM. Equipped with D.C. control panel and starting equipment.



Actual Photograph

1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

1000 KW (1250 KW 2 hrs. 55 deg. C rises) GENERAL ELECTRIC direct current generator 125/250 volts 3-wire 720 RPM direct connected to 1400 HP 80% P.F. (1750 HP 2 hours 55 deg. C rise) GENERAL ELECTRIC synchronous motor 3 phase 60 cycle 13200/6600 volts 720 RPM. Equipped with D.C. breakers.

THE NATIONAL POWER MACHINERY CO.
1921 SCRANTON ROAD CLEVELAND, OHIO

BELYEA OFFERS

STOCK EQUIPMENT

shipment as fast as conditions allow

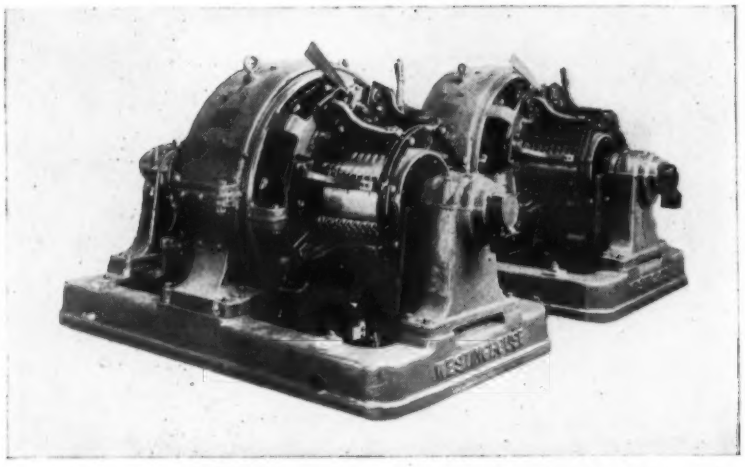


Photo above shows 2- 1000 KW, 600 volt, 60 cycle rotary converters which have been completely renovated. Once used for railway service, these units now help build ships.

ROTARY CONVERTERS

Primary 3 Phase 60 Cycle

1—1500 KW WHSE., 720 R.P.M., D.C. 600 V. A.C. 26400/13200 V.
1—1500 KW WHSE., 600 R.P.M., D.C. 600 V., A.C. 11500/10300 V.
1—1250 KW G.E., HCC, 720 R.P.M. D.C. 250 V., A.C. 2300 V.
1—1000 KW WHSE., 900 R.P.M., D.C. 600 V. A.C. 11000/23000 V.
2—750 KW WHSE., 1200 R.P.M., D.C. 600 V. A.C. 5500/2300 V.
1—750 KW WHSE., 720 R.P.M., D.C. 250 V., A.C. 6600/2200 V.
1—500 KW WHSE., 900 R.P.M., D.C. 250 V., A.C. 6600/2200 V.
1—500 KW WHSE., 1200 R.P.M., D.C. 600 V., A.C. 2300 V.
3—375 KW WHSE., 1200 R.P.M., D.C. 250 V., A.C. 6600/2200 V.
3—300 KW G.E., HCC, 1200 R.P.M., D.C. 600 V., A.C. 2300 V.

ROTARY CONVERTERS

3 Phase, 25 Cycle Boster Type

2—1500 KW G.E., HCC, 500 RPM., D.C. 225/275 V., 6000 Amp., A.C. 13200/6600 V.
1—500 KW G.E., HCC, 750 R.P.M., D.C. 225/275 V., 2000 Amp., A.C. 6600 V.

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1500 KW G.E., 600 V. D.C. to 2100 H.P. 6600 V.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 2200 V.
2—250 KW G.E., 250 V. D.C. to 375 H.P. 2200 V.
1—150 KW G.E., 250 V. D.C. to 200 KVA, 440 V.
1—150 KW G.E., 575 V. D.C. to 225 H.P. 2300/4000 V.
1—125 KW WHSE., 250 V. D.C. to 200 H.P. sq. cg., 440 V.
1—100 KW WHSE., 250 V. D.C. to 150 KVA, 2300 V.
1—100 KW WHSE., 250 V. D.C. to 175 H.P. sl. rg. 2200 V.
1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.
2—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.
1—40 KW WHSE., 230 V. D.C. to 45 KVA 2300 V.

TURBO GENERATOR SETS

1500 KW Whse. 625 Kva. 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.
1—500 KW G.E. 625 Kva. 2300 V. 3 ph. 60 cy. with Curtis 4-stage 150 lb. cond. turbine with cond. and access.
1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM.

GEAR REDUCTION UNITS

1—2100 H.P. Whse. 1800/360 RPM.
1— 943 H.P. G.E. 5306/1200 RPM.
1— 750 H.P. Al. Ch. 3600/600 RPM.
1— 450 H.P. G.E. 5600/1200 RPM.

A. C. MOTORS

3 Phase—60 Cycle

SLIP RING

HP	Make	Type	Volts	Speed
2—1200	Cr. Wh.	801Q	2300	237
1— 800	Al. Ch.	ANY	440	885
1— 600	G.E.	IM	2200	900
1— 500	G.E.	IM	440	392
1— 450	Whse.	HW	2200	875
1— 400	Al. Ch.	ANY	440	1200
1— 400	G.E.	MT	550/440	300
1— 400	Al. Ch.	ANY	2300	505
1— 350	G.E.	MT-442	2300/4000	257
1— 300	Whse.	CW	2300	600
1— 250	G.E.	MT	4000/2300	257
1— 250	G.E.	MT-410	2300	390

A. C. MOTORS

SQUIRREL GAGE

HP	Make	Type	Volts	Speed
1—500	G.E.	I-17B	2200	690
1—400	Whse.	CS-1104A	2200	585
1—300	Whse.	CS	550	580
1—300	G.E.	IK	440/2300	600
1—250	Al. Ch.		220/440	1150
2—200	Whse.	CS	2300	1200
1—200	G.E.	IK	2200	490
1—200	Whse.	CS	4600	900
1—200	Whse.	CS	440	580
1—100	Whse.	CS	550	1750
1—100	G.E.	KT-558	440	900

A. C. GENERATORS AND SYNC. MOTORS

3 Phase—60 Cycle

KVA	Make	Type	Volts	Speed
1—750	Whse.		6600	720
1—625	Whse.		480	900
1—500	G.E.	TS	440	360
1—250	G.E.	ATB	2300	600
1—250	G.E.	ATI	220	450
1—159	Whse.		2400	900
1—150	Whse.		4000	1800
1—100	Whse.		2400	900
1—125	G.E.	ATB	240	257
2—100	Whse.		2300	1800
1— 45	Whse.		2300	514

TRANSFORMERS

60 Cycle

KVA	Make	Ph.	Type	Voltages
1—1500	Whse.	3	OISC	26400/13200/440
3—1000	G.E.	1	HKDD	13200x2300
3—1000	Pitts.	1	OISC	2300/4600x575
4— 525	G.E.	1	HJ-DD	2300x445
2— 333	Pitts	1	OISC	2400x220
3— 300	Pitts.	1	OISC	2300x115/230
3— 300	G.E.	1	H	13200x2300/575
2— 200	G.E.	1	HILD	26400x115/460
3— 200	G.E.	1	H-KDD	13800x220/440
3— 150	Whse.	1	SK	2200x440/220
3— 150	Whse.	1	SKM	2400x120/240
6— 100	Whse.	1	SK	6900x460/230
3— 100	Whse.	1	OISC	13200x250

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1500	Whse.		550	330
2—1250	G.E.	MPC	500	130
1— 800	G.E.	MPC	550	600
2— 625	G.E.	MPC	250	130
2— 600	G.E.	MPC	550	600/800
1— 600	Whse.		230	150/275
1— 350	G.E.	MPC	230	450
1— 300	G.E.	MCF	230	400/1000
6— 300	G.E.	DMC	230	400/600
1— 300	Cr. Wh.	CMC 102H	230	1150
2— 300	Whse.		500	250/400
1— 300	G.E.	MPC	230	275/550
1— 300	G.E.	MPC	230	250/440
2— 200	Whse.		230	400/500
1— 175	Whse.	SK	250	150/525
7— 150	G.E.	RC-19	230	800/1000
2— 150	Whse.	SK	230	300/900
2— 125	G.E.	CO-1832	230	625
3— 120	Whse.	SK	230	720
1— 100	Al. Ch.		230	950/1150
3— 100	G.E.	LC	230	1200
1— 100	G.E.	MPC	230	225/450
1— 100	Whse.	SK	230	600
2— 100	G.E.	RC-19	230	575-720
1— 75	Whse.	SK	230	475/900
1— 75	G.E.	C	230	500/1000
4— 60	Diehl	K-11	230	500/1000
3— 60	Cr. Wh.	CMC-65H	230	500/1000
4— 50	G.E.	RC-16	230	650/815
1— 50	Cr. Wh.	CMC-81H	230	300/900
1— 50	Cr. Wh.	CMC-80H	230	380/750
1— 50	G.E.	RC	230	400/1200

RE-NU-BILT BELYEA MOTORS

SUCCESSFUL OPERATION GUARANTEED

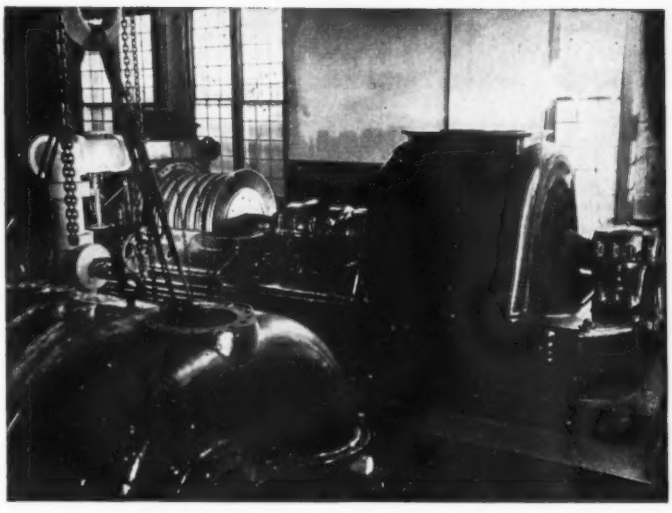
BELYEA COMPANY INC.

Main Office & Shop: 43 HOWELL ST., JERSEY CITY, N. J.

PAUL STEWART and COMPANY

HEAVY POWER PLANT EQUIPMENT

CINCINNATI



7500 Kw Condensing Turbo-Alternator

7500 KW 80% Curtis General Electric 6-stage Impulse Pattern Condensing Turbo (in record log service performing at 10/11000 KW.) Unit is 60/3/5000/1800 RPM/200# 150° Superheat (has been operated standardly under 250# ISP). Steel steam chest and throttle valve; generator mica insulated. Standard operating temperature rated 40°C. Wheeler Surface Condenser equipped.

CONDITION: In personal disassembly inspection accompanied by parent experts, recently completed, the fact of quality almost equal to new has been verified.

TURBOS—60 cycles

15000 KW performance 40° Impulse and Reaction Semi-Double Flow Condensing unit with non-automatic bleeder facility, 200# design (approved and adaptable with slight changes for 400# and non-automatic in max. volume at either 100# or 65# GPB (single parallel theory for 2300 volts). Surface Condenser and all auxiliaries complete. "In RANGE".

6250 KVA, 60/3/2300/3600, 200#, 125° superheat, Westinghouse semi-double flow Condensing, now with jet condenser, surface type procureable from other stores. Requires some minor reblading, extra blading in stock, however.

2000 KW rated Allis-Parsons (approx. 3000 KW normal) 60/3/440, no Condenser (would operate efficiently at approx. rated log NC plan at approx. 18# GP).

2000 KW GE Curtis 4-stage Impulse design 60/3/2300/1800 RPM Condensing and Non-Automatic Bleeder, Surface Condenser equipped. Has log record of 2600 KW constant at 40°. Total log service record 8000 hours (approved non-automatic bleeder theory 30,000# 20# BP. 1800/2000 KW performance.

2000 KW Westinghouse Reaction design 60/3/2300/1800 RPM. Now Barometric Condenser equipped. Officially approved for NC plan at minimum 1500 KW 18# BP. Operators vouch for first-class condition throughout.

A number of smaller units in the range of 300, 500, 750, 1000, 1250, and 1500 KW, in the classifications of low pressure (12#), mixed pressure, and medium and high pressure (350#) condensing and non-condensing, both surface condenser and jet condenser equipped sets are available.

TURBOS—25 cycles

50,000 KW total aggregate capacity—In unit sizes of 3000 to 6000 KW—Complete sets with Surface Condensers—First Class Condition.

SURFACE CONDENSERS

Surface condenser units complete in following general capacity range 20,000 sq.ft., 15,000, 12,000, 11,000 and 8,200 sq.ft. Also other smaller units.

WATER TUBE BOILERS

4—350#, 120,000# per hour cross drum units, superheater and underfeed stoker equipped.

2—330# design, 100,000/120,000# per hour Bent Tube steam generation units, powder fuel fired. One unit complete with boiler house stack, etc. Completely retubed and rebuilt equal to new.

4—700 HP, 160,000# steam per hour, straight tube, box steel header, 200# ASME, no firing equipment.

8—400 HP B&W STIRLING 200# ASME POWDERED COAL FIRED, SUPERHEATERS, SOOT BLOWERS, FORCED DRAFT FANS, FEEDWATER HEATERS, COAL AND ASH HANDLING, METERS, GAUGES, ETC.,—STEEL BUILDING CAPABLE OF DISMANTLING—SHORT LOG SERVICE—200# APPROVED—RECENT INSPECTION.

12—200/500 HP range, Straight Tube and Bent Tube 200# boiler units.

"SQUARE COOPERATION IN HEAVY POWER THRU THREE WARS"

KIEMLE OF TOLEDO, OHIO

MOTORS
GENERATORS
CONTROLS
TRANSFORMERS
MOTOR GENERATOR SETS
ETC.

BERGER OF ROCHESTER, N.Y.

Put all idle equipment to work. Send your list for prompt action.

TRANSFORMERS

4—500 KVA Gen. Elec. Type H form KDD, 60 cy. Single Phase, Primary 6900V or 11950 Y; secondary 2300V—with primary taps—circular coil H design.
6—150 KVA Gen. Elec. type H 2200/220/440 25 cy. single phase.
1—200 KVA Allis Chal. 60 cy. 3 ph., 220/440.
1—300 KVA Gen. Elec. 60 cy. 3 ph., 220/440.

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KVA Gen. Elec. Ft. Wayne 3 ph., 60, 220/440, 720 RPM, revolving field.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.

D. C. GENERATORS

150 KW Western Elec. BYG. 3 wire, 115/230 V, 600 RPM.
75 KW General Electric C. L. Comp. Wound 3 wire 120/240 Volts 850 RPM.
50 KW Milwaukee, Comp. Wound 125 V, 600 RPM.

FREQUENCY CHANGERS

All sizes, voltages and cycles.

★400 H. P. SYNCHRONOUS MOTOR★

Complete A.C. Synchronous Motor

1—400 H.P. Wsghse Syn. motor, 3 ph, 60 cy 4000/2300 V, 400 RPM with built-in magnetic clutch. Complete panel mounted reduced voltage type Starting Control. Motor-Generator Set—factory built for excitation and clutch operation. 10 KW, 125 V, DC 1750 RPM, Type SK63, Wsghse, with direct conn. 15 HP, Type CS, 3 ph, 60 cy, 220/440 V.

3 ph. 60 cy. A. C. MOTORS

H.P.	Make		Type	Speed	Volts
300	Gen. Elec.	Sl. Rg.	I Form M	600	220/440
200	Wsghse.	Sl. Rg.	CW	900	220/440
200	Gen. Elec.	Sq. Cg.	I Form K	514	220/440
175	Ideal	Sl. Rg.	AVA	1750	2200
150	Gen. Elec.	Sq. Cg.	I K	600	2300
150	Burke	Sq. Cg.	3 BRG. 2 ph	900	220/440
125	Gen. Elec.	Sq. Cg.	I K	720	220/440

3 ph. 25 cy. MOTORS

H.P.	Make		Type	Speed	Volts
200	Wsghse.	Sl. Rg.	CW	485	220/440
200	Gen. Elec.	Sl. Rg.	I Form M	485	220/440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
150	Gen. Elec.	Sl. Rg.	I Form M	750	2200
100	Wagner	Sl. Rg.	BR	750	220/440
100	Gen. Elec.	Sl. Rg.	I Form M	750	220/440
100	Wsghse.	Sq. C.	CS	500	220/440
75	Wsghse.	Sq. C.	CC6	500	220/440
75	Triumph	Auto Start		750	220/440
75	Wagner	Sq. C.	BM	750	2200
75	Gen. Elec.	Var.	BTA	375/750	440

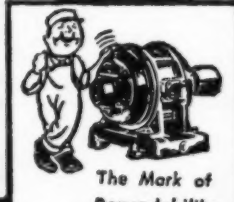
230V D. C. MOTORS

H.P.	Make	Type	Speed
150	Burke	Comp. Inter.	450/700
105	Gen. Elec.	CL/6 Shunt Wound	700
100	Sprague	C Interpole	600
100	Northwestern	K30 Comp. Inter.	1750
100	Wsghse.	SK143 Shunt Inter.	1750
85	Gen. Elec.	Vert. Comp. Wound	700
40	Fair. Morse	Ball BRG. Vert. Comp.	1740
32	Sturdevant	C Form P. Shunt Wound	190

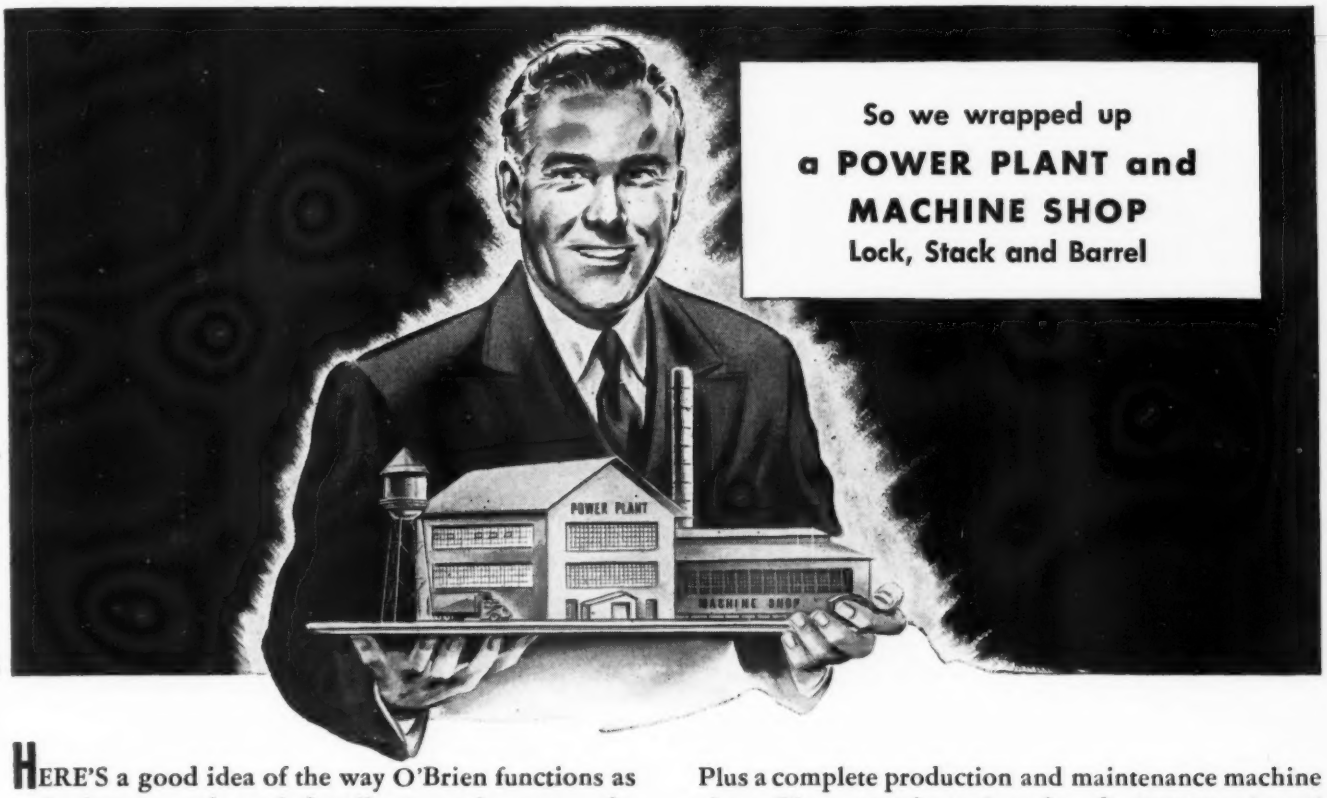
Only partial listing—Write or wire your inquiries

OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.

BERGER BROTHERS
ELECTRIC MOTORS, Inc.
395 STATE ST.
ROCHESTER NEW YORK



THE FRED W.
KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO OHIO



HERE'S a good idea of the way O'Brien functions as a single source of supply for all your equipment needs: A customer wanted a complete power plant. We found what he desired down to the smallest pump . . . steel buildings, 2-500 H.P. boilers with stokers, coal and ash handling equipment, boiler feed pumps, feed water heater, all piping and accessories. Plus 937 KVA and 1875 KVA steam turbine generator sets, complete with condensers, pumps; switchboards. Plus a complete production and maintenance machine shop. Plus a 100 ft. steel stack and a 50,000 gal. steel water tank on steel supports. We purchased the entire plant, dismantled it, sold it to the customer and shipped it 500 miles. The complete plant was re-erected at destination under O'Brien supervision. In 5 month's time the plant was running without a hitch in its new location. If you want to buy or sell a complete plant or order a few machines—call O'Brien.

ONE SOURCE . . . ONE RESPONSIBILITY

A Selected List of Current Offerings—Subject to Prior Sale

COMPLETE POWER PLANT No. 1

Installed in Pennsylvania—Available as Entirety or Separate Units—includes—

1-4000 KVA Al. Ch. Condensing Turb. 3/60/2300/3600 RPM.
1-3125 KVA General Electric—Curtis Condensing Turbine, 3/60/2300/3600 RPM.
1-1500 KVA West. Cond Turbine,. 3/60/2300/3600 RPM.
6-600 HP Sterling W.T. Boilers, with soft coal stokers.

With above is included condensers, exciters, pumps, switchboards; all accessories for turbines, boiler feed pumps, feed water heaters coal handling and ash handling equipment, forced draft fans, and all trimmings for boilers.

600 K.W. SKINNER UNIFLOW SET

750 KVA General Electric A.C. Generator, 3 phase, 60 cycle 2300 volt, 150 RPM direct connected 28"x36" Non Condensing Uniflow Engine 145 lb. Atmospheric Exhaust Steam Rate 18.5# per H.P. hr. with exciter and switchboard. Can be seen running—Condition like new.

COMPLETE POWER PLANT No. 2

In stock for immediate shipment.

2-250 HP International Engineering Works Manning Type Vertical Self Contained Boilers 200 lb. W.P. A.S.M.E. Complete with all trimmings.
1-500 KW Westinghouse Turbo Generator Set, 3 phase, 60 cycle, 2300 volt, 900 RPM with direct connected exciter connected thru reduction gears to 6000 RPM Non Condensing turbine 150 lb. 50° Superheat atmospheric ex.

MARINE DIESEL ENGINE

240 HP Fairbank, Morse Model B 35, 4 cylinder direct reversing, 260 RPM size 14x17, Serial No. 674850, with all trimmings—available for immediate purchase, rebuilt, guar.

MOTOR GENERATOR SETS

1000 KW General Electric 3 unit Set with 2—500 KW, 150 volt D.C. Generators—1400 HP Synchronous 3 phase, 60 cycle, 4000 volt 514 RPM.
275 KW Allis-Chalmers 3-unit Set, 450 RPM—150 KW Gen., 150 volt and 125 KW Gen., 240 volt 400 HP Syn. Motor 3/60/4500 volt.

Everything from a Pulley to a Power House

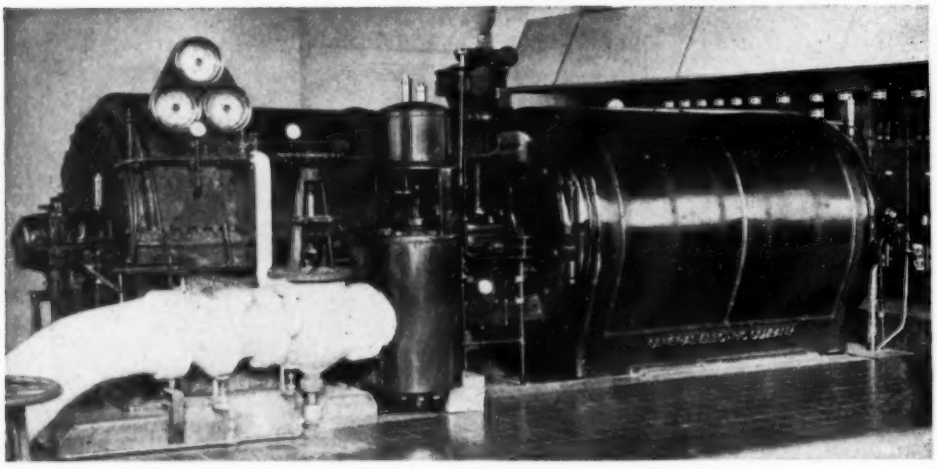
THE O'BRIEN MACHINERY CO.

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

113 NORTH THIRD STREET • PHILADELPHIA - PENNA.

BELL TELEPHONE: MARKET 4180 CABLE ADDRESS. OBRIEN-PHILA

2500 KW CONDENSING TURBINE-GENERATORS UNIT



AVAILABLE IMMEDIATE DELIVERY

3125 KVA—2500 KW 80% P. F., General Electric, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 180-200 lbs., pressure, 500 degree total temperature, equipped with surface condenser, condensing auxiliaries, panels and instruments. A complete installation.

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

6250 KVA Westinghouse condensing 175-200 lb. pressure, 2300 volts, complete with surface condenser and auxiliaries.

1875 KVA General Electric condensing 175-200 lb. pressure, 500° T.T., 2300 volts, 3600 RPM complete with surface condenser.

1250 KVA General Electric condensing 200 lb. pressure, 500° T.T., 2300 volts, 3600 RPM complete with surface condenser.

937 KVA General Electric condensing 200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with condenser, exciter, switchboard and instruments.

937 KVA Allis condensing 150 to 200 lb. pressure, 475° T.T., 2300 volts, 3600 RPM, complete with direct connected exciter, surface condenser and auxiliaries.

625 KVA General Electric condensing 200 lb. pressure, 2300 volts, 3600 RPM, complete with condenser and auxiliaries.

375 KVA General Electric condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) General Electric non-condensing, 150-175 lb. pressure, 5 lb. back pressure, 2300 volts, 3600 RPM each complete with direct connected exciter and rheostats.

ENGINE-GENERATOR UNITS

Direct Current

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. pressure, equipped surface condenser.

600 KW Crocker-Wheeler 250 volts, 300 RPM generator direct connected to a 14" x 18", 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. gauge back pressure, complete switchboard and instruments.

300 KW Westinghouse 250 volts, 175 RPM generator direct connected 24" x 26" Skinner Unaflow non-condensing engine, 110-150 lb. pressure, 5 lb. back pressure.

150 KW Crocker-Wheeler, 125 volts, 200 RPM generator direct connected to an Erie Ball single cylinder, 4-valve, non-releasing Corliss engine complete with switchboard.

50 KW General Electric, 125 volts, 1200 RPM generator direct connected 75 HP Terry non-condensing turbine, 150 lb. pressure, 15 lb. back pressure, complete with switchboard.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

500 KVA G.E. 240/480 volts, 150 RPM generator direct connected 26" x 32" Skinner Universal Unaflow non-condensing engine, 130-160 lb., 6 lb. back pressure.

438 KVA G.E. 2300 volts, 200 RPM generator direct connected Busch Sulzer vertical full Diesel engine.

312 KVA Elliott 4000/2300/550 or 240 volts, 180 RPM generator direct connected 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. gauge back pressure.

300 KVA G.E. 240 volts, 120 RPM generator direct connected 18" x 36" Hamilton Corliss engine, 125-150 lb. pressure, 5 lb. gauge back pressure, complete with exciter.

135 KVA G.E. 2300 volts, 277 RPM generator direct connected Busch Sulzer vertical full diesel engine.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volts, 300 RPM synchronous motor.

100 KW Triumph 250 volts direct current generator direct connected to 150 HP, 3 phase, 60 cycle, 2300 volts, 900 RPM squirrel cage motor.

30 KW G.E. 125 volts direct current generator direct connected to 50 HP, 3 phase, 60 cycle, 2300 volts, 720 RPM squirrel cage motor.

13.5 KW G.E. 125 volts direct current generator direct connected 20 HP, 3 phase, 60 cycle, 440 volts, 900 RPM squirrel cage motor.

MOTORS—

3 phase, 60 cycle

1500 HP Allis-Chalmers, 2300 volts, 200 RPM slip ring.

625 HP G.E. type ATI, 2200 volts, 257 RPM synchronous.

620 HP G.E. type ATI, form S, 440 volts, 164 RPM synchronous.

600 HP Westinghouse, 2200 volts, 345 RPM slip ring.

150 HP (5) G.E. form K, 2200 volts, 580 RPM, in the 4 million series, each complete with G.E. automatic compensator.

125 HP 80% P.F. Elec. Mchy. 440 volts, 400 RPM synchronous with starting equipment.

50 HP G.E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

MISCELLANEOUS

1500 KVA, 3 phase, 60 cycle, 22,000 volt primary, 2300 volt secondary Westinghouse transformer.

1200 KVA G.E. 3 phase, 60 cycle, 2400 volt, 300 RPM alternating current generator direct connected to a 1700 HP, 3 phase, 25 cycle, 2300 volt synchronous motor.

725 HP Heine water tube code boiler, gas fired, 250 lb. pressure—complete.

500 KVA Ideal, 3 phase, 60 cycle, 240 volts, 400 RPM, three-bearing belted type generator with direct connected exciter and rheostats.

200 KVA Westinghouse, 3 phase, 60 cycle, 240 volts, 200 RPM engine type generator with rheostat.

30 KW G.E. 125 volts, 625 RPM, type RC compound wound direct current generator.

1—Elliott jet condenser with auxiliaries suitable for a 5000 KW turbine-generator unit.

1055 cubic feet, 100 lb. air pressure Chicago Pneumatic horizontal compressor direct connected to 170 HP, 240 volt, 150 RPM General Electric direct current motor.

SynchronousCondensers 1350 KVA Total Capacity

750 KVA and 600 KVA General Electric, type ATI, 3 phase, 60 cycle, 240 volts, 900 RPM synchronous condensers. Each unit complete with direct connected exciter, switchboard panel with instruments. Are in A#1 operative condition—still on original foundation for operating test.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

REBUILT POWER EQUIPMENT

READY TO SHIP!

ROTARY CONVERTERS

1—200 kw. G. E. 275 v. 900 rpm., 6 ph. 60 cy. complete with overspeed device and transformers.

1—500 kw. G.E. type HC-8 600 volt, 900 rpm., 6 ph., 60 cy. pedestal bearing with overspeed device complete with transformers.

MOTOR GENERATOR SETS

150 KW Ridgway 250 v. D.C. 900 rpm. dir. con. 2300/3/60 syn. motor, complete.

100 kw. G.E. 550 v. 900 rpm. dir. con. 2200/3/60 Syn. Motor.

1—75 kw. G.E. 250 v. 900 rpm., dir. con. 2300/3/60 Syn. Motor.

ENGINE GENERATOR SETS

225 kw. Elec. Machy. 2200 or 220 v. 2 ph. 60 cy. dir. con. Ideal Steam.

1—225 kw. Elec. Machy. 2200/220 or 440 v. 3 ph. 60 cy., 200 rpm., dir. con. Ideal Engine 4 valve non-releasing.

100 HP. LIGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)

2—120 kw. G.E. 220/440 v. 3 ph. 60 cy. 900 rpm., 80% P.F.

SLIPRING MOTORS—3 ph. 60 cy.

No.	HP	Make	Type	Volts	rpm.
1	1500	West.	CW	2200	435
1	700	G. E.	MT-432	2200	393
1	400	West.	CW-967A	220/440	1170
1	400	G.E.	I	2200	514
1	300	G.E.	I		
1	260	Burke	EMV-65	220/440	600
3	250	G.E.	I-M	550	600
3	250	G.E.	I-M	2200/220/440	600
3	200	G.E.	M	2200/220/440	600
1	100	West.	CI	220/440	1750
1	100	G.E.	I-M-16	2200	450
1	75	West.	CW	220	875
1	60	West.	HF	2200	690
1	60	Triumph	C-16	220/440	430
2	60	G.E.	MT-536	2200	1150
1	53	G.E.	I-M	220/550	1165
1	52	G.E.	ITC-5013	220/440	570
2	50	Allis. Chal.	ANY	220/440	900
1	50	West.	HF-12A	220/440	900
2	50	West.	HF	220/440	1120
1	50	West.	CW-636A	220/440	1150
2	40	G.E.	MT-332	220/440	1155
1	40	G.E.	MTC-5522	220/440	1125
1	25	West.	MW	220	680
1	25	West.	CI	220	900
1	20	Cr.Wh.		220	850
1	20	G.E.		220/440	865
2	20	West.		220	1750
1	15	West.	HF	220	1150
1	15	G.E.	MT-310	220	1150
1	7½	G.E.	MTC5180	220	1800
1	5	West.	HF	220/440	670

SYNCHRONOUS MOTORS

1—125 kw. G.E. type ATB. 220/440 v. 3 ph. 60 cy. 900 rpm., 80% PF.

SPEED REDUCERS

5—¼ HP Pgh. Gear 720 rpm. ratio 52:1
5—½ HP Pgh. Gear 840 rpm. ratio 52:1
5—1 HP Pgh. Gear 1800 rpm. ratio 52:1
1—3 HP Farrell Birmingham 1160 to 193 rpm. ratio 6:1
3—10 HP Horsburg & Scott 1200 rpm. ratio 6:1
1—150 HP Falk 1200 rpm. ratio 7.3:1
1—150 HP Nuttal ratio 1.6:1
1—450 HP Kerr 3800 rpm. ratio 5.8:1

TRANSFORMERS—1 ph. 60 cy.

3—1500 Kva. Pittsburgh Transformers. 22,000 volt Primary. 6900/6600/2200 volt secondary.

No.	Kva.	Pri.	Sec.	Make	Ph.
1	250	2300	460	G.E.	
3	150	22000	6900	Pgh.	
1	150	2200	230/460	G.E.	3 ph.
1	100	2200	110/220	G.E.	
3	100	6600	550/440/220	Pgh.	
2	75	2200	220	Burke	3 ph
2	50	2300	220/440	G.E.	
3	50	11430/6600	550	Al. Ch.	
3	50	6600	575	G.E.	
1	37½	2300	220/440	Wagner	
3	37	4400	185	West.	(Rotary)
1	30	2200	110/220	G.E.	
2	30	440	220/110	West.	
25	25	2200	122/244	G.E.	
3	15	2200	122/244	G.E.	
35	10	2200	122/244	G.E.	
40	10	2200	122/244	West.	
100	7½	2200	122/244	G.E.	
50	7½	2200	122/244	West.	
50	5	2200	122/244	G.E.	
75	5	2200	122/244	West.	
1	3	2200	115/230	G.E.	
4	2	2080	115/230	G.E.	
3	1	4400/2200	122/244	West.	

SERIES MOTORS—230 v.

1—175 HP G. E. type MD-109¼ 475 rpm.
1— 68 HP G. E. CO-2007, 475 rpm.
1— 50 HP Shaw.
1— 50 HP West. K-10 (500 v.) 435 rpm.
1— 15 HP Crocker Wheeler 270 rpm.
6— 2 HP Reliance, 850 rpm.

AIR COMPRESSORS

2—260 CFM Chic. Pneu. 12x10, 100# pres. 285 rpm., belt driven by 40 HP G.E. AC slipring Motors.

SQUIRREL CAGE MOTORS—3 ph. 60 cy.

Qu.	HP	Volts	Make	Type	Speed
29	1½	220/440	Ilg.		490
2	15/30	220/440	West.	MS	550/1100
7	50	220/440	Wagner		850
3	60	220/440	Allis Chal. with		1150
2	60	220/440	Cr. Wh.		670
2	75	220/440	G.E.	I-K	720
1	75	220/440	West.		750
1	125	440	G.E.	I-K	720
1	125	220/550	G.E.	I-K	400
1	125	440	G.E.	I-K	450
1	125	440	G.E.	I-K	514
1	125	220/550	G.E.	I-K	850
1	150	220/440/550	G.E.	I-K	514
1	150	220/550	G.E.	I-K	450
1	150	550/220/440	G.E.		575
1	200	2200	West.	CS	870
1	200	220/440	West.	CS	580
1	200	2200/440/220	West.	CS	250
1	200	440	G.E.	I-K	720
1	200	220/550	G.E.	I-K	600
1	200	220/550	G.E.	I-K	514
1	225	2200/440/220	G.E.	TR	200
1	250	220/550	G.E.	I-K	720

VARIABLE SPEED MOTORS—230 v. D.C.

1—2 HP G.E. type FC-33 500/2000 rpm.
1—2 HP G.E. 500/1500 rpm.
1—2 HP Westg. type SK-9 1150/2300 rpm.
3—2½ HP G.E. 500/1000 rpm.
1—2¾ HP Westg. type SK-20 900/1800 rpm.
2—3 HP Jantz Liest 650/1900 rpm.
1—3¼ HP Westg. type SA 400/1600 rpm.
1—3½ HP Westg. type SK-30 850/1700 rpm.
1—5 HP G.E. type CD-85 450/1800 rpm.
1—5 HP G.E. type LC 990/1500 rpm.
1—5 HP Sprague 850/1500 rpm.
3—7½ HP Cr. Wh. 385/1000 rpm.
2—7½ HP Westg. type SK-6 495/990 rpm.
1—10 HP Westg. type S 565/1130 rpm.
2—10 HP G.E. type LC 625/1250 rpm.
1—10 HP G.E. type CD-95 450/900 rpm.
1—10 HP Reliance 110 v. 450/1800 rpm.
1—20 HP Westg. type SK-120 700/1400 rpm.
1—30 HP Westg. type SK-123 850/1275 rpm.

DIESEL ENGINE GENERATOR SET

217 KVA G.E. 2300/3/60 dir. con. 260 HP Buckeye 2 cyl. 200 rpm. semi-diesel engine, complete.

ELEVATOR

1—Westinghouse Elevator, traction type, 3000 lbs. Cap., platform 6x5, 2 gates on car, 4 sets of bi-parting doors, planed steel tees for main guides complete with AC motor and constant pressure control. All automatic.

INDUSTRIAL TRUCKS

1—Elwell Parker Tow Tractors 7' L. x 42" W. x 42" H. 4-16" wheels, ball bearing, 4 wheel steer, 4 wheel drive, 2000# DBP complete with Edison Batteries.

1—Baker Tow Truck 8'1x64"hx48" w.

50—Small steel trucks with oak platforms 42"x24" heighth 17" with 4—12" roller bearing wheels and 5th wheel including handles.

SCALES

6—Fair. Morse ± 11½ 3 beams (2—200# ea. 1—50 lbs.) platform 16¼x21⅝.

9—Howe Scales 3 beams—platform 14½x22.

★ *FOR VICTORY TODAY AND SOUND BUSINESS TOMORROW—BUY WAR SAVINGS BONDS* ★

WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS

DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH, PA.

The HEAT is on — America needs more POWER

CHECK THIS LIST OF ITEMS READY FOR IMMEDIATE DELIVERY

BOILERS AND STOKERS

2—253 HP Heine Water Tube Boilers 160# pressure, ASME code

1—Jones 300 HP 3 Retort underfeed stoker, Steam actuated ram type

CONDENSER

1—C. H. Wheeler 3650 Square Feet Surface Condenser 2 pass, complete with pumps

SYNCHRONOUS MOTORS

1—268 HP G.E. with belted exciter, 2300 volt, 600 RPM

1—125 HP Westinghouse, 2300 volt, 900 RPM

1—75 HP General Electric with direct conn. exciter, 220 volt, 900 RPM

MOTORS

220/440 Volt AC—Squirrel Cage

Quan.	HP	Make	Speed
1	150	West	495
2	150	Al.Ch.	720
1	125	CW	900
1	50	West	720
1	50	GE	1800
1	50	Wag	600
1	40	Rel	900
1	30	Wag	720
2	30	Rel	1200
1	30	GE	900
1	25	GE	900
3	20	Rel	900
1	20	West	1200
1	20	U.S.	720
5	15	Rel	900
1	15	Wag	900
2	15	Cent	1200
2	15	GE	900
2	10	AC	1200
1	10	GE	1800
1	7 1/2	West	1200
2	5	GE	3600
1	5	West	1800
2	5	GE	1200
5	3	Imp	3600
3	3	Cent	1200
2	1 1/2	Cent	900
4	1	Wag	1200

2300 Volt—Squirrel Cage

Quan.	HP	Make	Speed
3	100	GE	720
3	75	GE	900
4	75	GE	720
2	60	GE	900
2	50	GE	900
1	40	GE	1800
2	35	GE	900
2	10	GE	1800

Quantity of small sizes from ½ to 10 H.P. in addition to those listed.

230 Volt DC

Quan.	HP	Make	Type	Speed
1	100	Rel	T	500
3	50	West	SK	565
1	40	AC		950/1150
1	35	GE	LC	650
1	30	AC		575
1	25	West	S	650
1	20	West	SK	850
1	20	Rel	T	825
7	15	GE	RC	850
2	15	West	SK	850
1	15	West	SK	1150
6	15	Rel	T	850
1	10	West	SK	1325
1	10	GE	RC	1750
2	7 1/2	GE	RC	1150
2	7 1/2	West	SK	1750
1	7 1/2	GE	CD	1750
6	7 1/2	CW	CCM	850
5	5	West	SK	850
1	5	West	SK	400/1600
2	5	GE	RC	1150
1	5	West	SK	1750
3	3	Roth	RS	500/1000
1	3	GE	RC	1750
2	3	West	SK	1150
3	3	West	SK	850
4	2	GE	RLC	415/830
3	2	CW	CCM	1150
2	2	West	SK	850
5	1 1/2	Rel	14 T	500/1000

★ MISCELLANEOUS

45 KW Diehl Cpd. Int. 550 RPM 230 V. D. C. Generator

1—16 ton 50 ft. span overhead travelling crane, hand operated

Large lot leather belting (approx. 7 tons) all sizes

Large lot new bronze valves 2" to 4"

Steam pumps—Sump pumps

★ TUBES

7,500 Condenser Tubes 1" OD 20 Gauge Admiralty 18 ft., long like new

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Send us your list of idle or standby equipment— before you scrap.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

HEAT

45 BOND ST.

and here are 2 COMPLETE POWER PLANTS for you!

Formerly Owned By

VULCANITE PORTLAND CEMENT CO.

ALPHA, NEW JERSEY—3 miles from Phillipsburg, N. J., and Easton, Pa.

PLANT NO. 3

3—800 HP B & W Straight Tube Waste Heat Boilers, 200# pressure complete with Economizers, motor driven induced draft fans, and steel stacks.

2—400 HP B & W Straight Tube Water Tube Boilers, 200# pressure complete with Combustion Engineering Type E stokers and induced draft fans.

Complete Coal Pulverizing Department consisting of:

4—Fuller Lehigh Pulverizers — Jeffreys 24 x 24 Coal Crusher, Ruggles 6' x 41' Rotary Dryer, Conveyors, elevators, etc.

1—Cochrane Feed Water Heater.

2—Steam driven Feed Water Pump 14 x 20 x 22 x 15.

1—Cameron Centrifugal Feed Water Pump motor driven, 150 HP.

1—Cooper Tandem Compound Corliss Engine 24 x 54 x 48.

1—Cooper Tandem Compound Corliss Engine 20 x 44 x 48.

3—Horizontal Cross Compound Corliss Engine direct connected to 230 volt DC Generators, one 800 KW, one 750 KW, one 400 KW.

1—Ingersoll Rand Air Compressor, horizontal duplex 11 x 16; 18 x 16, belted motor drive.

PLANT NO. 2

2—Edgemoor 800 HP Waste Heat Boilers 200# pressure complete with Economizers, Super Heaters, motor driven blowers and steel stacks.

2—1000 HP Cochrane Feed Water heaters.

Complete coal pulverizing department consisting of:

3—Fuller Lehigh Pulverizers, Ruggles 5' x 30' Rotary dryer, conveyors, elevator, etc.

1—20 x 36 x 42 Horizontal Cross Compound Corliss Engine.

3—Horizontal Cross Compound direct connected to 230 volt DC Generators 100 RPM, one 400 KW, one 450 KW, one 575 KW.

1—Ingersoll Rand Air Compressor, horizontal duplex 18¼ x 14 x 18, belted motor drive.

ONE HUNDRED MOTORS AND STARTERS

230 volt DC from 1 to 300 HP

1—300 HP 500 RPM Electric Dynamic.
1—125 HP General Electric 550 RPM.
3— 30 HP SK Westinghouse, Variable Speed 600/1000.
1— 35 HP DLC 600/1800 General Electric, Var. Sp.
1— 75 HP Westinghouse SK 1750 RPM.
1— 60 HP Westinghouse SK 1600 RPM.
3—25/100 HP MPC General Electric, Variable Speed 300/600.

See opposite page for partial list of AC Motors.

★

CEMENT MAKING EQUIPMENT

24 buildings of cement making machinery; Dryer—Kilns—Crushers. Pulverizers, Hoists, and Complete Quarry Equipment. 24 Steel buildings suitable for re-erection. Inventory now being made. Write for details of any equipment needed.

Representative on Premises
Phone Phillipsburg 5-1111

POWER COMPANY *Inc.*

ALgonquin 4-3874 **NEW YORK CITY, N. Y.**

DEPENDABLE

Turbo-Generators

A PARTIAL LIST OF OUR INVENTORY

1—G.E. 3125-KVA, 3600-RPM, Condensing: 3/60/2300-v, 200#, 100° SH, 28" vacuum: Surface or Low Level Jet Condenser.

1—Westinghouse 2500-KVA, 3600-RPM, Condensing: 3/60/600-v, 200#, 100° SH, 28" Vacuum: Low Level Jet Condenser.

1—G.E., 1875-KVA, 3600-RPM, Condensing: 3/60/600-v, 200#, 100° SH, 28" Vacuum: Surface or Jet Condenser.

1—G.E., 1563-KVA, Non-condensing 3600-RPM, 3/60/600-v: 150#, 100° SH, 20# back pressure.

1—Allis-Chalmers 1250-KVA, 3600-RPM, 3/60/2300-v, 200#, 500° TT: Surface Condenser.

1—Westinghouse, 1000 K.W. 250-v, direct current, condensing, 150/250-Lbs., Surface Condenser.

1—Allis-Chalmers 937-KVA, 3600-RPM, Condensing: 3/60/2300-v, 200#, 500° TT: Surface Condenser.

1—G.E., 625-KVA, 3600-RPM, Condensing: 3/60/2300-v, 200#, 500° TT, 28" vacuum.

1—G.E., 250-KVA, Non-condensing, 3600-RPM: 3/60/480-v, 150#, 0° SH, 28" Vacuum, 10# G. back pressure.

WILMS, WEAVER & CO. Penobscot Building DETROIT, MICH.

We Deal in Turbo-Generators Exclusively

Let MacCABE lift your Worries!

OVERHEAD ELECTRIC TRAVELING CRANES

	Tons	Make	Span	Current
(2)	1	Euclid	20'0"	115/230-VDC.
(2)	1	Maris	35'7"	230-VDC.
(1)	2	P & H	34'8"	230-VDC.
(2)	3	Sprague	20'6"	230-VDC.
(1)	3	Armington	To Suit	230-VDC.
(1)	3	Euclid	30'0"	220/440-VAC.
(1)	5	Shepard Niles	30'0"	230-VDC.
(1)	7½	P & H	38'0"	230-VDC.
(1)	10	Whiting	32'0"	220/440-VAC.
(1)	10	Toledo	33'0"	230-VDC.
(1)	10	P & H	38'0"	230-VDC.
(1)	10/5	Chesapeake	38'0"	230-VDC.
(1)	12	Morgan	58'0"	230-VDC.
(1)	25	Milwaukee	48'0"	230-VDC.
(1)	25	Niles	35'0"	230-VDC.
(1)	25	P & H	50'0"	A.C. or D. C.
(1)	40	P & H	50'0"	230-VDC.

ELECTRIC TRAVELING GANTRY CRANES

(1)-3-ton Milwaukee 3-motors, cage operated, 31'3" between legs, 13'3" overhang each end, 25'0" lift, (Rebuilt either 230-VDC. or 220/440-VAC.), suitable for 5-ton cap., drum parallel with bridge girders, used with single line bucket (bucket available).

(2)-Shaw **one leg** Gantries, 3-motors, cage operated, 230-VDC., (1)-5-ton cap., (1)-10-ton cap., 20'7½" span, 10' overhang one end.

(1)-15-ton McMyler Gantry, 5-ton high speed Aux. Hoist, 80'0" span, 30'0" lift, 4-motors, cage operated, (still erected) for easy inspection and quick shipment), now 550-V., 3-phase, 25-cycle. We can furnish this Rebuilt for 230-VDC. or 220/440-V., 3-PH, 60 CY.

(1)-50-ton Morgan Gantry, (2)-25-ton trolleys, 230-VDC., cage operated, 60'0" between legs, 50' cantilever extension each end, total bridge length 160', 35' lift, including 3400' of rail, ties, 3400' #40 bare copper wires with supports. (Available for Immediate Shipment, Still Erected).

230-V.D.C. CRANE & MILL MOTORS

	H.P.	Make	Type	R.P.M.
(1)	1	P & H	Size 5½x3½	850
(1)	2	P & H		
(1)	2	Shaw	B.E.	930
(2)	2½	Westgshe	Type K-1	930
(1)	2½	Reliance	Type T	1600
(2)	2½	G.E.	C.O. 2502	750
(1)	3½	G.E.	C.O. 2503	
(6)	2½	G.E.	C.O. 2505	650
(1)	6	C.W.	S.M.	930
(15)	6-7½	G.E.	C.O. 1805	850/1150
(1)	7½	Westgshe	M.T.-000	Back Axle
(1)	7	G.E.	M.D.-102	1000
(10	10	G.E.	C.O. 1806	700
(1)	10	P & H		
(2)	10	G.E.	M.D.-2504	700
(1)	10¾	C.W.	S.M. size	616-810
(2)	10	Westgshe	K-5	700
(15)	15	G.E.	C.O.-1807	650
(1)	19	C.W.	B.W.	Mill type
(1)	20	G.E.	C.O. 1808	850
(1)	25	G.E.	C.O. 1809	700
(1)	25	G.E.	Type 52	
(2)	20/30	G.E.	M.D.-104	725/575
(4)	30/45	G.E.	M.D.-104½	625/500
(1)	50	Shaw	Type Z	550
(2)	50	G.E.	C.O.-1810	550
(3)	65/85	G.E.	C.O. 1830	700/650
(2)	65/85	G.E.	C.O. 1811	700/550
(1)	100	G.E.	C.O. 1812	700
(1)	150	Westghse	MCB	365

(250) Drum Controllers (G. E. Westinghouse, C. H.) EC&M Dinky type, with and without resistors, 5 to 100-HP. for many of the above motors and for sale separately. **(Send Us Your Controller Specifications).**

SPECIAL: 25-sets G. E. controllers, R-177-A each with 20 to 30 and 30 to 45-HP. resistors.

As we operate the largest plant in the country exclusively Rebuilding all kinds of Overhead & Gantry Cranes, Hoists, Crane & Mill Electrical equipment, we can rebuild and adjust most of the cranes noted above to your requirements.

(Send Us Your Inquiries for All Kinds of Electrical Equipment)

T. B. MacCABE COMPANY

4306 CLARISSA STREET PHILADELPHIA, PA.

ELECTRIC EQUIPMENT STOCK LIST

25 CYCLE MOTORS

Alternators—Synchronous Motors

3 phase, 25 cycle

HP	KVA	Make	Type	Volts	RPM
600	KVA	G.E.	ATI	550	500
300	HP	Elec.	Mach.	440	214
100	HP	Elec.	Mach.	440	600
75	HP	Elec.	Mach.	2200	500
20	KW	Ideal		240	1500

SQUIRREL CAGE

220-440 volt 3 phase

HP	Make	Type	Volts	RPM
300	G.E.	I-K	440	1500
150	G.E.	I-K	440	750
150	West.	CS	440	1500
125	G.E.	Kt 561	440	750
100	West.	CCL	440	500
100	G.E.	I-K	440	750
75	G.E.	I-K	440	750
75	G.E.	I-K	440	500
60	Lincl.	IN	220	1500
50	G.E.	I-K	440	750
50	G.E.	KT 353	440	750
50	F-Morse	H-16B	440	750
50	West.	CS	440	750
50	West.	CS-W505	440	1500
40	West.	CS	440	750
40	G.E.	KT 343	440	750
40	Al.-Ch.	AN	440	1500
40	G.E.	KT 337	440	1500
40	Ele.Dyn.	B.B.	440	1500
35	G.E.	I-K	440	750
35	West.	CS	440	750
35	G.E.	I-K	440	1500
30	Wagn.	22VBP	220	750
30	G.E.	KT	440	750
30	G.E.	KT 343	440	750
30	West.	CS Tot.En.	440	750
25	G.E.	KT	440	750
25	G.E.	I-K	440	750
25	West.	CS	440	750
25	Wagn	19BP	440	1500
25	Watson	KH	440	1500
25	Linc.	II	440	1500
25	Burke	473	440	1500
25	G.E.	KT 523	440	1500

Also 150 motors from 20 HP. to 1 HP. Ilspeeds.

SQUIRREL CAGE

2200 volt AC 25 cycle, 3 phase

HP	Make	Type	Volts	RPM
100	G.E.	I-K	2200	1500
100	G.E.	KT 553	2200	1500
100	West.	CCL	2200	500
75	West.	CS	2200	750
50	West.	CS	2200	750
50	Al-Ch.	AR 226M	2200	1500
50	G.E.	I-K	2200	1500
40	West.	CS	2200	750
35	I-K	G.E.	2200	500
30	G.E.	KT 337	2200	750
30	West.	CS 753	2200	750

SLIP RING

3 phase, 25 cycle

125	Al-Ch.	AN	440	750
125	G.E.	I-M	440	1500
100	G.E.	I-M	2200	375
100	G.E.	MT 357	440	1500
75	G.E.	I-M	2200	750
75	G.E.	I-M	2200	500
75	West.	CI 756A	440	500
60	West.	CW 765A	440	750
50	Al-Ch.	ANY	220	380
50	G.E.	I-M	440	750
50	West.	CW	440	750
40	West.	CW	440	750
37	G.E.	ITC 5015	220	750
30	Al-Ch.	ARY	440	1500
25	G.E.	MT 337	220	750

25 other motors smaller than 25 HP. In Stock.

60 CYCLE MOTORS

SQUIRREL CAGE

HP	Make	Type	Volts	RPM
200	G.E.	I-K	2200	600
200	G.E.	KT 557	550	1800
200	Cr.Wh.	SC	220	3600
200	Al-Ch.	AR 226	2200	1200
200	West.	CS	2200	1200
150	G.E.	I-K-16	2200	600
150	Al-Ch.	AN	2200	900
150	Al-Ch.	AR	440	900
150	G.E.	I-K	2200	1200
150	West.	CS	440	1800
150	West.	CS 771.C	2200	1800
150	G.E.	I-K 13A	2200	1800
125	Tmph.	TR 14	440	1800
125	G.E.	I-K	4150	450
125	West.	CS B.B.	2300	3600
100	G.E.	I-K	2200	720
100	G.E.	KT 556	2200	900
100	G.E.	I-K	440	900
100	Al-Ch.	AR 226D	440	900
100	G.E.	KT 543	440	1200
100	G.E.	I-K	440	1800
100	West.	CS B.B.	2300	3600
75	G.E.	KT 552	2200	900
75	G.E.	KT 352	440	900
75	G.E.	KT 552	440	900
75	Howell	SC	440	1800
75	West.	CS	440	1800
75	Ideal	A306 B.B.	440	3600
75	Lo. Al.	EX 505	5550	3600
60	G.E.	KT 333	440	1800
50	G.E.	I-K 15A	440	300
50	G.E.	I-K	440	720
50	G.E.	KT 542	550	900
50	G.E.	KT 336	550	1200
50	G.E.	KT	440	1800
50	F-Mse.	HO121C	440	3600
50	G.E.	KT 527	2200	1800
50	F-Mse.	B.B.	2200	3600
40	West.	CS	550	385
40	Linc.	C15	440	720
40	Linc.	IN	2200	720
40	G.E.	KT 342	220	900
40	West.	CS	2200	900
30	Al-Ch.	AR 220C	220	900
30	G.E.	KT 336	220	900
30	West.	CS	440	1200

200 Motors 30 HP. and smaller all speeds and types in stock

SLIP RING

500	G.E.	MTP 565	2200	1800
400	G.E.	I-P	2200	257
300	G.E.	I-M	2200	1200
200	G.E.	I-M 17A	440	514
200	G.E.	I-M 17	550	514
200	G.E.	I-M 17	2200	600
150	G.E.	I-M 16	2200	600
150	G.E.	I-M 16	550	600
150	West.	CW	2300	720
150	Cr-Wh.	Late	440	900
150	G.E.	I-M	2200	900
150	G.E.	I-M 15	440	900
150	West.	CW 771.1c	440	1800
125	G.E.	MT 547	2300	1800
112	G.E.	ITC 5015	550	514
100	G.E.	MT 356	440	900
100	G.E.	I-M	440	900
100	G.E.	I-M	440	1800
75	Al-Ch.	ANY	440	514
75	G.E.	MT 556	550	720
75	G. E.	MT 356	2200	720
75	G.E.	MT 356	2200	900
75	G.E.	I-M	220	1800
60	G.E.	MT 556	440	600
60	G.E.	MT 352	440	720
60	G.E.	MT 346	440	900
50	G.E.	I-M	440	514
50	G.E.	MT 352	2200	720
50	G.E.	MT 352	220	720
50	G.E.	MT 346	2200	900
50	G.E.	I-M	440	1200
50	G.E.	MT 536	440	1200
50	West.	CW	440	1800
50	G.E.	I-M	440	1800
40	West.	CW	440	720
40	G.E.	MT 346	440	720
40	G.E.	MT 342	440	900
40	G.E.	MTC 5522	440	1200
40	West.	CW	440	1200
40	G.E.	MT 332	550	1200
30	G.E.	MT 336	440	900
30	G.E.	MT 532	550	900
25	G.E.	MT 326	440	900
15	G.E.	MT 312	440	900

50 Smaller slip ring motors 15 HP. and smaller any speed.

DIRECT CURRENT MOTORS

CONSTANT SPEED—115 volt

HP	Make	Type	RPM
100 KW.	G.E.	DLC	1000
75 KW.	G.E.	CD 145	720
75	Sprague	LC	700
60	Rel.	Intpl.	1200
27½ KW.	Al-Ch.		1200
20 KW.	G.E.	DLC	650
20	G.E.	RC 31	1200
20	G.E.	RC 30	1150
15	G.E.	CVC 116	700
15	G.E.	CVC 115	925
15	W.S.H.	SK	1150
15	G.E.	RC 29	1200
15	Ideal	A 9	1440
10	West.	SK	1120
10	G.E.	CVC	1250

50 Motors—115 volt—10 HP. and under, all speeds.

VARIABLE SPEED—115 volt

30	Nthn	20801	250/1000
25	West.	SK	1100/2200
15	G.E.	RC 12	575/1150
15	West.	SK	1110/1650
10	West.	SK 91	250/1000
7½	G.E.	RF 9	600/1800
7½	G.E.	RA 30	650/1300
7½	West.	SK 90	450/1800
5	G.E.	RF 8	650/1950
2	G.E.	CD 73	500/2000
2	G.E.	RF 7	575/1800

CONSTANT SPEED—230 volt

300	G.E.	DMC INT	800
100	West.	SK 160	1200
100	G.E.	CD 123	1200
75	G.E.	RC 18	600
75 KW.	Cr. Wh.	81 H Gen.	725
75	Cr. Wh.	516761	1050
60	G.E.	RC 34	1050
60	Al-Ch.	E 123	1800
60	West.	SK 123L	1800
50	Cr. Wh.	CMC-H50	750
50	Rlnc.	310T	900
50	Al-Ch.	E 123	1200
50	Al-Ch.	E 131	1150
40	G.E.	RC 15	700
40	G.E.	RC 31	700
40	West.	SK	775
40	G.E.	LC	930
40	G.E.	RC	1050
40	G.E.	DLC	1050
40 KW.	West. gen.	SK	1800
35 KW.	G.E. gen.	DLC	900
30	West.	SK 133	600
30	G.E.	RC 12	1100
30	G.E.	RC 31	1150
30	West.	SK	1150
30	G.E.	RCP 31	1700
25	West.	SK 120	825

Also 130 other DC motors—40 HP. and smaller any speed.

VARIABLE SPEED—230 volt

175	G.E.	DLC 208	650/ 925
80	Burke	CD 60	200/ 625
60	Sprg.	Intpl.	480/1200
50	G.E.	RLC	400/1200
35	West.	SK	500/1500
35	G.E.	RLC	500/1500
35	West.	SK 150	400/1200
35	G.E.	RF 14	400/1200
30	West.	SA 8	500/1500
30	El. Dy.	208	400/1200
25	West.	SK 140	400/1200
25	El. Dy.	208	400/1200
20	West.	SK	400/1200
20	G.E.	RLC 115	600/1200
20	G.E.	RLC 203A	300/ 900
15	West.	80 L	1150/1800
15	G.E.	RF 13	300/ 900
15	West.	SK 93	600/1800
13	G.E.	RLC 115	500/1500
12	West.	SK	600/ 900
12	West.	SK 100L	375/1500
11	West.	SK 90	500/1500
11	West.	SK 90	450/1400
10	West.	SK 90	600/1800
10	G.E.	RF 11	250/1000
10	G.E.	RF 10	600/1800
10	West.	SK 90	450/1800
10	G.E.	RF 10	400/1600
10	G.E.	RLC	500/1500
7½	Reliance	131T	300/1200
7½	G.E.	RF 10A	450/1800

45 motors, 230 volt DC variable, all speed, 13 HP. or smaller.

MOTOR GEN. SETS

250 volts DC.

1—300 KW. Al. Ch. late factory built set, 250 v., 900 rpm. comp. intpl. on base to 710 KVA. Al. Ch. synch. motor, 2300 v., 60 cy., 3 ph. 900 rpm. with panels.
1—150 KW. Cr. Wh. late DC, comp. intpl. factory built 250 v. 120 rpm. to 225 HP. Cr. Wh. synch. motor, 3 bg. set. 440 v., 60 cy., 3 ph., 1200 rpm. with panels.
1—100 KW. Cr. Wh. factory built set 275 v. DC. 1800 rpm. comp. intpl on base to 150 HP. Type SC Cr. Wh. motor, 2200 v., 60 cy., 3 ph., 1800 rpm. with starter.
1—50 KW. G. E. type RC, 250 v., 900 rpm. on base to 75 HP. KT 552 motor 2200 v., 60 cy., 3 ph., 900 rpm.
1—15 KW. G. E. type CD 83, 230 v., 1800 rpm. to a 25 HP. G. E. type KT 503, 550 v., 60 cy., 3 ph., 1800 rpm. on base with starter.

125 volt DC.

1—75 KW. G. E. type RC 18, 125 v., 720 rpm. comp. intpl. factory built to 115 HP. G. E. type I-K, sq. cg. motor, 2200 v., 25 cy., 3 ph., 750 rpm. with starter.
1—35 KW. G. E. type CD 95, 125 v., 1800 rpm. factory built comp. intpl. to 50 HP. G. E. type FT 527, sq. cg., 2200 v., 60 cy., 3 ph., 1800 rpm. complete.
1—30 KW. West. type SK factory built, 125 v., 1200 rpm. to 50 HP. West. type CS 440 v., 60 cy., 3 ph. 1200 rpm. motor, complete.
1—25 KW. Imperial factory built very late type, 125 v., 1800 rpm. shunt intpl. to a 40 HP. Imperial motor, 220 v., 60 cy., 3 ph., 1800 rpm.
2—22 KW. West. type SK 83, factory built, 125 v., 1800 rpm. on base to 38 HP. West. type CS 565C, motors, 220/440 v., 60 cy., 3 ph., 1800 rpm. complete.
1—17 KW. G. E. type CVC set, 125 v., 1200 rpm. comp. intpl., to a 25 HP. G. E. type I-K, sq. cg. motor, 550 v., 60 cy., 3 ph., 1200 rpm.

We also have 15 Mo. Gen. Sets 15 KW. and smaller, 125 v. or 250 v. Send us your inquiries.

LOW VOLTAGE

1—850 Ampere G. E. type CD factory built, 32 v., 1200 rpm. comp. intpl. on base to 40 HP. G. E. type KT 532 motor, 440 v., 60 cy., 3 ph., 1200 rpm.
1—600 Ampere G. E. type RC set, factory built 32 v., 720 rpm. on base to 30 HP. G. E. type KT 342, 440 v., 60 cy., 3 ph., 720 rpm. motor.

AC GENERATORS

60 CYCLE

HP.KVA	Make	Type	Volts	RPM
300 KVA	G.E.	ATB-PB	480	720
250 HP.	West.	4846672	240	1800
240 HP.	G.E.	ATI	200	514
225 KVA	G.E.	ATB	220	720
200 KW.	G.E.	ATB-PB.	550	720
200 HP.	G.E.	ATI syn.	2300	900
150 KW.	West.	640451	2200	600
150 KW.	G.E.	ATI	2300	900
150 KW.	G.E.	ATB-PB	600	900
120 KW.	G.E.	ATB-PB	2300	720
105 HP.	El.Ma.	BRT	2300	1800
100 HP.	G.E.	ATI PB	2300	900
100 HP.	G.E.	ATI-PB	220	900
75 KW.	G.E.	ARB-PB	2300	900
75 KW.	G.E.	ATB-PB	550	900
60 KVA.	G.E.	ATB-P	2300	900
60 HP.	G.E.	ATI-PB	4000	900
54 KVA.	G.E.	ATB	220	900
50 KW.	G.E.	TRB	240	1200
50 KVA.	West.	AC gen.	240	1200
37½KVA	G.E.	ATB-PB	240	1200
25 KW.	G.E.	TAB	240	1800

40 Generators AC. in stock 20 KW. or smaller. Write for details.

1250 HP IDEAL, 4000/2300 Volt, 1200 RPM, Direct Conn. Exciter

Above is only partial list, many additional items are always being added. Send us your requirements.

OUR STOCK INCLUDES THE FOLLOWING

TRANSFORMERS — SAFETY SWITCHES — CAPACITORS
METERS — PANEL BOARDS — COMPENSATORS
MOTORS — ALTERNATORS — GAS ENGINES

We will buy for cash and resell to defense plants.

ELECTRIC EQUIPMENT CO.

680 LAKE AVE. · PHONE: Glenwood 6783 · ROCHESTER, N. Y.

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.
1—12000 KW General Electric Cond.
1— 6250 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 2850 KVA Westinghouse Cond.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA General Electric Cond.
1— 375 KVA General Electric Cond.
1— 250 KVA General Electric Cond.
1— 938 KVA West. 375# I.P. 100# B.P. N-C.
1— 937 KVA Moore-Allis N-C. Bleeder
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Moore Non-Condensing
1— 125 KVA Westinghouse Non-C.
1— 63.5 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.
1—1067 KVA Nordberg Uniflow
2— 937 KVA Nordberg Uniflow
1— 325 KVA Skinner Uniflow
1— 312 KVA Chuse Uniflow
1— 300 KVA Hamilton 4-valve
1— 187 KVA Chuse Uniflow
1— 150 KVA Hamilton Poppet Valve

DC STEAM ENGINE UNITS
1—500 KW Skinner Uniflow 250 V.
1—350 KW Ridgway 4-valve 250 V.
1—300 KW Skinner Uniflow 250 V.
1—300 KW Erie City 4-valve 250 V.
1—200 KW Chuse 4-valve 250 V.
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire
1— 75 KW Skinner Uniflow 250 V.
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL & GAS ENGINE UNITS—60 Cy.
1—1000 KVA Cooper (gas) 240 V.
1— 720 KW McInt.-Seymour 2300 V.
1— 400 KW West. (gas) 440 V.
1— 312 KVA Anderson 2400 V.
1— 49.5 KVA Fairbanks Morse 120 V.
1— 32 KVA Fairbanks Morse 120 V.

WATER TUBE BOILERS
4—1000 HP Heine 250-lb. Oil Fired
1—1000 HP Edge Moor 200-lb. Stoker
1— 800 HP Connelly 250-lb. Stoker
4— 750 HP Edge Moor 200-lb.
6— 600 HP Stirling 180-lb. Stokers
1— 512 HP Stirling 200-lb. Stoker
2— 490 HP Stirling 200-lb.
8— 400 HP Stirling 200-lb.
1— 400 HP B. & W. 160-lb. Stoker
2— 350 HP Stirling 200-lb.
2— 336 HP B. & W. 200-lb. McClave-Brooks Stokers
1— 300 HP Kingsford 160-lb. Pulverized Coal
1— 253 HP Stirling 180-lb.
2— 250 HP Heine 160-lb.

SYNCHRONOUS MOTORS—60 Cy.
2—800 HP Electric Machy. 6600 V. 450 RPM
1—200 HP General Electric 2200 V. 1800 RPM
1—175 HP General Electric 230 V. 225 RPM
1—175 HP General Electric 220 V. 200 RPM
1—150 HP General Electric 440 V. 164 RPM
1—100 HP General Electric 2300 V. 240 RPM

INDUCTION MOTORS—60 Cy.
4—3500 HP G. E. slip ring 2300 V. 120 RPM
2— 800 HP G. E. slip ring 2300 V. 300 RPM
2— 400 HP G. E. slip ring 3800 V. 1800 RPM
2— 300 HP G. E. sq. cage 440 v. 600 RPM
2— 250 HP G. E. sq. cage 4000 V. 1200 RPM
1— 250 HP G. E. slip ring 2200 V. 450 RPM

MOTOR GENERATOR SETS—60 Cy.
1—1500 KW General Electric 600 V. DC
1—1000 KW General Electric 600 V. DC
1— 500 KW General Electric 600 V. DC
1— 300 KW General Electric 275 V. DC
1— 75 KW General Electric 125 V. DC

FREQUENCY CHANGERS
2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA G. E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1500 KW G. E. 25/60 cy. 300 RPM
1—1250 KVA G. E. 25/62½ cy. 750 RPM
1—1000 KVA G. E. 60/25 cy. 514 RPM
1—1000 KW G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 25/60 cy. 300 RPM

ROTARY CONVERTERS—60 Cy.
1—1000 KW Westinghouse, 600 V.
1— 750 KW Westinghouse, 600 V.
1— 500 KW General Electric, 250 V.
1— 500 KW General Electric, 600 V.
2— 300 KW General Electric, 600 V.

OIL CIRCUIT BREAKERS
1— 800 A. 87 KV Am.Br.Bov. AF22 Outdoor
2— 600 A. 73 KV West. G222AS Outdoor
1— 400 A. 73 KV G. E. FKO36 Outdoor
2— 600 A. 37 KV Condit F040A Outdoor
4— 400 A. 34.5 KV Condit F-16-A Outdoor
2—1000 A. 30 KV Kelman CB-76 Outdoor
4— 600 A. 25 KV West. CO-2 Outdoor
2— 600 A. 15 KV Kelman CB-76 Outdoor
4— 600 A. 15 KV G. E. FKO-60-B Outdoor

SYNCHRONOUS CONDENSERS
1—4000 KVA G. E. 13200 V. 514 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1—1000 KVA G. E. 2300 V. 900 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.
3— 600 KVA West. 120,000/2300 V.
3— 200 KVA G. E. 66000/13200-22800 V.
3— 500 KVA Allis 33000/480 V.
6— 250 KVA Penn. 34500-17250/4600-2300 V.
3— 75 KVA G. E. 33000/13200-11000 V.
2—10000 KVA G. E. 26400/4580 V. 3 ph.
1— 6000 KVA G. E. 26400/2300 V. 3 ph.
3— 1500 KVA Pitts. 22000/6600 V.
2— 1000 KVA G. E. 23000-11500/575 V.
4— 667 KVA West. 22000-11000/2300 V.
3— 250 KVA G. E. 22000/11000 V.
1—10000 KVA Pitts. 13200/4600 V. 3 ph.
2— 5000 KVA American 13800/2300 V.
1— 450 KVA G. E. 13200/240-480 V. 3 ph.
3— 200 KVA G. E. 13200/2300 V.
3— 150 KVA Pitts. 13800/230-460 V.
4— 1250 KVA West. 12000/2300 V.
3— 150 KVA Pitts. 11000/2400 V.
3— 100 KVA West. 11000/250-125 V.
3— 1250 KVA G. E. 6600/550 V.
3— 1000 KVA Pitts. 2300-4600/550 V.
3— 1000 KVA Kuhlman 2300/220 V.
3— 667 KVA G. E. 2300-4000Y/500-480-460 V.
4— 150 KVA G. E. 2400-4160/240-120 V.
6— 100 KVA Pitts. 2300/575 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK CITY

POWER PLANT EQUIPMENT CO., INC.

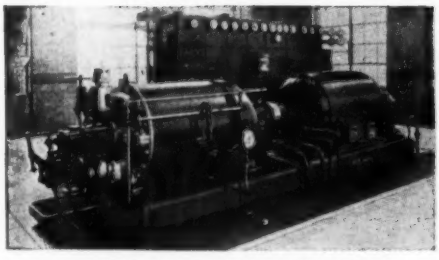
39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

9375 KVA G.E. 5000/2300 V. Cond.
6250 KVA. G.E. 2300 V. Cond.
2500 KVA G.E. 2300 V. Cond.
1875 KVA Al. Chal. 2300 V. Cond.
1500 KVA Al. Chal. 480 V., low press.
1250 KVA G.E. 2300 V. Cond.
1000 KVA Wghse. 2 ph., 600 V. Cond.
937 KVA Al. Chal.-Moore 480 V., Non-Cond. and bleeder
937 KVA Al. Chal. 2300 V. Cond.
937 KVA Al. Chal.-Elliot Mixed Pres.
780 KVA Al. Chal. 2300 V. Con.
780 KVA Al. Chal.-Terry 600 V.; Auto bleeder
625 KVA Wghse. 2300 V. Cond.
625 KVA G.E. 2300 V. Cond.
625 KVA Al. Chal.-Elliot 240/480 V. Auto bleeder
375 KVA G.E. 2300 V. bleeder
375 KVA G.E. 2300 V. Non-Cond.
312 KVA Ridgway-Elliot 480 V. Cond.
250 KVA G.E.-Moore; Auto Bleeder
150 KVA Wghse. 240 V. Cond.

STEAM ENGINE SETS

500 KVA G.E. 240/480 V.—Bates
255 KVA G.E. 240 V. Hamilton Corliss
200 KW G.E. 125 V.—Erie Ball 4 V.
200 KW G.E. 125 Skinner Uniflow
150 KW G.E. 240 V.—Erie Ball 4 V.
150 KVA G.E. 240 V.—Skinner s. v.
125 KW G.E. 240 V.—Erie Ball 4 V.
100 KW G.E. 240 V.—Erie Ball 4 V.
100 KW G.E. 125 V.—Erie Ball 4 V.
20 x 21 Skinner Uniflow, belted, 175 lbs. (15 to 25 lbs. b.p.)
18 x 20 Ames Uniflow; dir. con.



• BLEEDER TURBINE UNIT

625 KVA Allis Chalmers-Elliott 3 ph. 60 cy. 240/480 v.; automatic bleeder; with jet or surface condenser

TRANSFORMERS

687 KVA (2) Maloney 13800—460 V.
500 KVA (3) Al. Chal. 33000—440 V.
250 KVA (3) Packard 22000—2300 V.
250 KVA (2) G.E. 6600-2300 V.
150 KVA (2) G.E. 2300/4000-115/230 V.
100 KVA (3) Al. Chal. 22000—440 V.
100 KVA (6) G.E. 13200—2300 V.

FIRE PUMPS (Motor Driven)

1600 GPM Al. Chal. 216' head; dir. con.
1500 GPM Worthington 216' head; dir. con.
850 GPM Al. Chal. 243' head; dir. con.
8" Hill 2 stage; dir. con.

STOKER

1—Illinois Chain Grate for 1300 HP
2—Illinois Chain Grate for 350 hp.
2—Taylor Underfeed for 550 hp.
1—Combustion Engrg. Underfeed for 250 hp.

COAL PULVERIZERS

8000 lbs. Fuller Bonnett; Motor Driven
6000 lbs. Whiting; Motor driven
2—4500 lbs. Erie City; Motor Driven

BOILERS (ASME)

300 HP Badenhausen, 350 lbs.
749 HP (4) Edgemoor 200 lbs.
500 HP Murray (Heine) 180 lbs.
471 HP Erie City Vert. 200 lbs.
418 HP Sterling 200 lbs.
300 HP Erie City (Heine) 160 lbs.
298 HP (3) Sterling 200 lbs.

SURFACE CONDENSERS

3850 Sq. Ft. Worthington
2400 Sq. Ft. Al. Chal.
800 Sq. Ft. Wheeler
625 Sq. Ft. Wheeler

DIESEL ENGINE SETS

900 KVA G.E. 3 ph.—McIntosh-Sey.
375 KVA Wghse. 3 ph.—Busch-Sulzer
312 KVA Burke 3 ph.—Anderson
219 KVA G.E. 3 ph.—Worthington
200 KVA G.E. 3 ph.—Busch-Sulzer
40 KVA Fairbanks Morse 3 ph., 60 cy.

The Wise Solution To Wartime Power Problems Lies In Specifying

CHICAGO ELECTRIC GUARANTEED

REBUILT POWER EQUIPMENT

BOILER FEED PUMP
8½x5x10 Union, brass lined cylinder, steel piston rods, force feed lubricator.
VACUUM PUMP
16x10x12 Union, with brass lined cylinder, steel piston rods, force feed lubricator

MOTOR-GENERATOR

1000 KW G.E. 600 v DC 4000/2540 AC.
750 KW Elliott 250 v DC 440 v. syn.
300 KW Westg. 250 v DC 2200 v. syn.
235 KW Westg. 115 v DC 2200 v. syn.
225 KW Ideal 115 v DC 2200 v. syn.
150 KW Ideal 250 v DC 440 v. ind.
100 KW G.E. 3-wire, 2200/440, ind.
100 KW Allis C, 3-W. 4000/2200 ind.
100 KW G.E. 250 v. 2200 v. ind.
100 KW Wtg. 125 v. DC 2200 v. ind.
100 KW Al. Ch. 125 v DC 440 v. syn.
90 HP Wtg. 110 v DC 75 KVA 2200 v.
75 KW G.E. (2) 125 v. DC 3/25/220 AC.
75 KW G.E. 125 v DC 220 v. syn.
75 KW G.E. 250 v DC 440 v. ind.
75 KW G.E. 250 v DC 2200 v. syn.
50 KW Al. Ch. 115 v DC 2200 v. ind.
50 KW Al. Ch. 125 v DC 2300/440 ind.
50 KW G.E. 125 v DC 4000/2200 ind.

MOTOR-GENERATOR (Cont.)

33 KW G.E. 110 v DC 2200 v. syn.
22½ KW G.E. 125 v DC 220/440 ind.
15 KW Ideal 240 v DC 220 v. ind.
15 KW G.E. 220 v DC 220 v. ind.

SYNCHRONOUS

HP	Make	Volts	Speed
5000	G.E.	2300	82
2100	G.E.	4600/2300	514
800	G.E.	2300/4400	450
800	El. Machy.	6600	450
750	Wstg. (2)	4000/2200	1200
650	Al. Chal.	2200	1200
270	G.E.	2300	600
200	Wtg.	2200	225
190	Elec. Machy.	440	720

FREQUENCY CHANGERS
1400 HP 460 volts, 3 phase, 60 cycle, 30 RPM, 1570 amps. 1250 KVA power factor, .9 50-deg. rise, type ATI-24, 1250-M-300 form C, with amortisseur winding field amps. 102, 1000 KW, 460 volts, 3 phase, 25 cycle, 300 RPM, 1570 amps. 1250 KVA power factor .8 50-deg. rise type ATI-10-33-M-300 form C, amort. winding, field amps. 121, with 1250 direct-connected exciter.

25 CY. M.G.'S

75 KW General Electric, 125 volt D.C., 3/25/440 A.C. 750 RPM interpole, 3 brg.
75 KW Gen. Elec., 125 volt D.C., 3/25/220 A.C. 750 RPM, 2 brg.

MARINE ENGINES

2—500 HP Winton Model 130, overhead valve type Marine Gasoline Engines, 8" bore, 10" stroke, 8 cylinder, 4 cycle, at 1100 RPM. with: Dual ignition; Reversing Planetary gear; 100 lb. Standard Winton air starter; 4 Zenith carburetors; Gear type water pump; Water temperature thermometer; Instrument board with magneto switches; Oil pressure gauge; Air pressure gauge; Spark and throttle levers; etc.

SLIPRING

HP	Make	Type	Volts	Speed
2850	Wtg.	CW	6600/2300	253
1500	G.E.	MT	6600/2258	257
800	Wtg.	CW	6600/2200	443
800	Wtg.		2300	900
500	G.E. (2)	I-M	2200	600
350	G.E.	MT	2300	300
350	Al. Ch.		2200	300
300	G.E.	I-M	240	293
300	G.E.	I-M	2200	514
225	G.E.	I-M	220	600
200	Wtg.	CW	440	870
200	Howell	Rl. brg.	440	600
200	G.E.	I-P	440	1170
200	Wtg.	CW	440	345
200	G.E.	I-L	2200	585
200	Wtg.	CW	440	580
150	Wagner	BR	440	1140
150	G.E.	MT	440	875
150	Wtg.		440	600
150	Wtg.	CW	440	575
150	G.E.	I-M	220	600
150	G.E.	I-M	220	585
125	Wtg.	CW	2300	1750

ENGINES & BOILERS
Must sell as whole:
1000 KVA, 375 KVA, 62½ KVA, 360/440 v. AC Gens. with Skinner engines.
2—255 HP Boilers with Stokers.

PUMPS

GPM	Make	Head	Type
900	Union	70	1 st.
800	Amer.	325	3 st.
900	Gould	106	1 st.
500	Union	140	1 st.

SQUIRREL CAGE

HP	Make	Type	Speed
200	G.E.	I-K	1200
200	Wtg.	CS	580
200	G.E.	I-K	580
150	Wtg.	CCL	495
150	Al. Ch.		1170
100	G.E.	KT-356Y	900

Vertical Motors

4—60 HP 3/60/2200 1750 RPM
1—40 HP 3/60/440 1800 RPM

ROTARY CONVERTERS
1000 KW Westg. 600 v. DC 6 ph. 60 cy. 900 RPM, with panel and transformers.
2—100 KW Westg. 250 v. DC 3 ph. 60 cy. with switchgear and transformers.

ONLY PARTIAL LISTING—SEND FOR NEW CATALOGUE

For Complete Information, WRITE—PHONE or WIRE

CHICAGO ELECTRIC CO. • 1320 W. 22nd. St.

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE, 60 CYCLE, 220/440 V.

HP	Make	RPM	Type	Frame
5	West.	1200	CCL	2 phase
5	American	600	totally enc.	ball bearing
7½	Gen. Elect.	1800	KT	944
7½	Gen. Elect.	1800	KQ	944 2 phase
10	Fairbanks Morse	900	KBY	
10	Crocker Wheeler	900	Nema	365
10	Burke	1800		
15	Reliance	1200		2 phase
15	Howell	900		2 phase
20	Gen. Elect.	1800	KQ501	2 phase
20	Gen. Elect.	565	I	Form K
25	Gen. Elect.	1740	KQ312	2 phase
25	Armor	1200	ball bearing	2 phase
25	Gen. Elect.	1800	KT	312
30	Gen. Elect.	3600	KT	513
30	Armor	695	ball bearing	2 phase
50	West.	1200	MS	
50	Fairbanks Morse	1800	ball bearing	
50	Fairbanks Morse	1800	ball bearing	
50	West.	1800	CS	
60	Gen. Elect.	1800	I	form K
75	Gen. Eect.	1800	I	form K
75	Gen. Elect.	900	KT	552
100	Gen. Elect.	1800	I	form K
100	West.	1800	CS	
150	Gen. Elect.	1200	I	form K
150	Gen. Elect.	1200	I	form K

MOTOR GENERATOR SETS

1—100 KW Ridgeway sets 250 v. DC. 1200 RPM direct connected to 150 HP. Ridgeway synchronous motors, 3/2200/60/1200 complete with panels.
1—100 KW. Crocker Wheeler 250 v. DC 500 RPM direct connected to 150 HP General Electric Motor 3 PH 25 cycle 2200 volts 500 RPM, complete.
1—75 KW Ridgeway 140 v. DC 1200 RPM direct connected to 120 HP Ridgeway synchronous motor 3/2200/60/1200 RPM. Complete.
1—35 KW Westinghouse Generator 125 volt DC 1450 RPM direct connected to 53 HP West. CS motor 3 ph. 25 cy. 220 v. 1450 RPM. Complete.

25 Rotary Converter
1—150 Allis Chalmers Rotary 250 Volts D.C. 500 R.P.M. complete with panels. Transformer 25 cycle, 2300 volts.

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

HP	Make	Speed	Type	Frame
10	Gen. Elect.	1800	MT	303
15	Gen. Elect.	1800	I	form M
20	Gen. Elect.	545	MT	332
20	Westinghouse	575	CW	648A
20	Westinghouse	575	CW	ball bearing
25	Westinghouse	690	CW	
30	Gen. Elect.	1800	MT	327
30	Gen. Elect.	1800	I	form M
40	Westinghouse	690	CW	748
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
50	Westinghouse	900	CW	
60	Westinghouse	720	CW	2200 volt
75	Westinghouse	1800	CW	
300	Gen. Elect.	1200	I	form M
500	Westinghouse	600	CW	

TRANSFORMERS

Amt.	Kva.	Make	Cycle	Voltage
21	25	G.E.	25	2300/230/460
6	40	G.E.	5	2300/230/460
6	30	G.E.	25	2300/115/230
24	50	G.E.	25	2300/230/460
3	50	Packard	25	6900/230/460
18	50	G.E.	60	4160/4600/230/460
3	75	60	60	4160/4600/230/460
18	100	G.E.	60	4160/4600/230/460
3	100	Kuhlman	25	2300/230/460
3	200	G.E.	60	2300/230/460
3	200	G.E.	60	6900/230/460
3	200	Kuhlman	60	4160/4600/230/460
3	500	Pitts.	25	11500/220
3	1000	Pitts.	60	2300/4600/230/460

Prices on Application

3 PHASE, 25 CYCLE, 220/440 VOLTS

HP	Make	RPM	Type	Frame
50	Gen. Elect.	750	I	form K
50	Westinghouse	750	CS	
75	Gen. Elect.	750	KT	357
75	Gen. Elect.	750	I	form K
100	Gen. Elect.	750	I	form K
100	Gen. Elect.	300	117	form K
150	Gen. Elect.	750	I	form K
150	Gen. Elect.	750	I	form K
200	Westinghouse	460	CS	2200 volt
200	Gen. Elect.	750	I	form K
225	Elec. Machinery	500	2200 volt	synhronous
1150	Gen. Elect.	375	2300 volt	synchronous
200	Westinghouse	235	CW	slipring

SPECIAL MOTORS

1100 H.P. General Electric Synchronous Motor, 3 ph., 25 cy., 11,500/6600/2200 V., 375 RPM.
500 H.P. Allis-Chalmers, 3 ph., 25 cy., 440 V., 490 R.P.M., Complete.
300 H.P. G.E. Slipring, 25 cy., 3 ph., 2200 V., 500 RPM, 3 bearing; complete with controls.
225 H.P. Electric Mchy Co. Synchronous, 3 ph., 25 cy., 2200 V., 500 R.P.M. with controls.
1—100 H.P. G.E. Synch. Motors, 3 ph., 25 cy., 220/440 V., with control equipment.
1—20 HP. Gen. Elec. Motor 230 v. DC. Type CD83 1750 RPM.
1—75 HP. Westinghouse Motor Type SK, 230 v. DC 475/950 RPM variable speed.

FREQUENCY CHANGERS

2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM. direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 290 HP. Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.
1—120 KVA Gen. Elec. Induction Frequency Changer, 440 V., 3 Phase, 62½ Cycle. Driving motor 100 H.P., 3/25/440 RPM. Complete.
94 KVA Westinghouse Synchronous Set Generator, 63½ cy., 230 v., 750 RPM with panels. Motor 112 HP. 3/25/2300/750 Synchronous with starting equipment.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

SEARCHLIGHT SECTION

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
700	2200	G.E.	900
400 (2)	440	Whse.	514
350	220–440	G.E.	1800
350	2200	G.E.	600
300	2300–4000	G.E.	1200
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–440	G.E.	600
150	440–220	G.E.	1800
150	2200	G.E.	900
150	2200–440	Whse.	1800
150	550–2200	G.E.	1800
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
75	220–440	G.E.	600

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

600	2200	Whse.		900
400	440–220	Whse.		276
350	440–220	G.E.		900
240	2300–440–220	G.E.		600
200	2300–4000	G.E.		1200
	150 2200	G.E.		1800
	100 440–220	G.E.		1200

TRANSFORMERS—60 CYCLE

2—667 kva., G.E., 2300/4000-460/480 Volts.
3—667 kva., Whse. 22000-2300.
3—500 kva., Whse. 22000-2300.
3—350 kva., G.E., type H-KD 13200-2300.
3—333 kva., G.E., type H-KDD 2400-460/230.
3—250 kva., Whse. 13,800-460.
3—200 kva., G.E., type H 10000-600.
3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E. 4000-480.
3—150 kva., G.E., type H-KDD 13200-2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240/480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., Whse. 22,000-2300.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse. type SK, 13800-240/120.
3— 50 kva., Whse. 22,000-2300.

A.C. GENERATORS

1—500 kva., 900 r.p.m., 2209 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—225 kva., 600 r.p.m., 2200-240-V., G.E.
1—187 kva., 900 r.p.m., 2200-550-V., Westghse.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200	Whse.	C.S.	1800
50	2200	G.E.	IE-K	1800
250	2200	G.E.	I-K	600
200	220/440	G.E.	IK	720
150	2200	Allis. Ch.	AN	450
150	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E.	K	1800

MOTOR GENERATOR SETS

2—200 KW 125 V. 900 RPM Whse. Con. to 300 HP 2200 V. 3 Ph. 60 Cy. Ind. Motor. Also
1—100 KW 125 V. 900 Rpm GE Con. to 150 HP 200 V. Ph. 60 Cy. Ind. Motor.
1—75 K.W., 250 V., 1800 R.P.M., Cr. Wh., Type CCD con. to 100 H.P., 2200 V., 3 ph., 60 cy.
1—50 K.W., 250 V., 720 R.P.M. Whse., Type SK con. to 75 H.P. 220/440 V., 3 ph., 60 cy. Sq.c.

SYNCHRONOUS CONVERTERS

500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

250 KW G.E. SYN. 250 V. 2300/4000 A.C. 720 RPM
200 KW G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
200 KW G.E. IND. 600 V. 2300 A.C. 1200 RPM
200 KW R.W. SYN. 250 V. 2300/4000 A.C. 900 RPM
150 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM

TURBO GENERATOR SET

300 KW GENERAL ELECTRIC-CURTIS, 250 V. D.C. Turbine, Non-Condensing, 100# Steam Pressure, 3600 RPM. Gen. ELEC. 300 KW MPC Generator and D.C. Panel.

Each unit listed above is owned by us and is Available now for immediate purchase.

WALLACE E. KIRK CO.

Incorporated

502 Grant Building Pittsburgh, Pa.

Motor Generator Sets—Synchronous Motors, etc.

MOTOR GENERATOR SETS & ROTARIES
3 phase, 60 cycle, A.C.

2—West. 250 KW 250 Volt rotaries
1—West. 100 KW 250 Volt rotaries
1—Ridgway 100 KW 250 V. M-G set 2300 A.C.

VERTICAL MOTORS

1—G. E. 50 HP 1200 RPM 3 ph 60 cy 220 V.
1—Reliance Fan-cooled 25 HP 1750 RPM 220/440 V.

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A.C.

1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS 3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 60 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220/1440 Volts

1—150 HP 1750 RPM Allis-Chalmers
2—100 HP 550 RPM Westinghouse MS
1— 75 HP 575 RPM Westinghouse CS—368-A
1— 75 HP 600 RPM Fairbanks-Morse
1— 75 HP 720 RPM Lincoln I-P
1— 65 HP 860 RPM Allis-Chalmers
1— 50 HP 575 RPM Westinghouse CS—752-C
1— 50 HP 690 RPM Westinghouse CS—758
1— 50 HP 875 RPM Westinghouse CS
1— 50 HP 865 RMP Ideal
1— 50 HP 1200 RPM Northwestern H-50
1— 50 HP 1750 RPM Westinghouse CS—53-C
1— 40 HP 1200 RPM Northwestern H-50
5— 20 HP 870 RPM West. T.E.F.C. CS—W-405
2— 20 HP 870 RPM West. CS—W-405
2— 15 HP 860 RPM Allis-Chalmers

ALTERNATOR SPECIAL, Allis-Chalmers, 125 KVA, 277 RPM, 3 phase, 60 cycle

The Electric Motor & Repair Co., Cuyahoga Falls, O.

BOILERS

2—Single, sectional header with stokers, 450 H. P. (each), 200#
2—500 H. P. Stirling 200#, single
2—Longitudinal drum, box header, 175#
2—Cross drum, box header, 160#

H. P. BREARLEY
3423—91st Street Jackson Heights, N. Y.

April Specials

1—40 KW C-W Type CCD, 250 v., 1100 RPM
1—25 HP GE-MTC 3/60/550/720 New
2—30 HP C.W. 3/60/220/900
2—50 HP A.C. Slipring 3160/220/900

Wanted 550 Volt Motors. All Sizes.

MILTON WERBY & CO.
423 Atlantic Ave. Boston, Mass.

BOILERS

NEW and USED!

All makes & sizes for prompt shipments

2—500 H.P. Stirling 160#
1—312 H.P. Stirling 160#
3—300 H.P. B & W 150#
1—200 H.P. Heine 160#

We want to buy 50 HRT boilers from 100 to 200 H.P. 125# pressure or better.

J. F. DAVIS CO.

122 S. Michigan Ave. CHICAGO

TURBO UNITS—60 CYCLE

1—5000 KW G. E. condensing.
1—3200 KW Allis-Chalmers condensing.
1—2500 KW G. E. condensing.
1— 500 KW West. condensing.
1— 300 KW G. E. non-condensing.

TRANSFORMERS
Single Phase, 60 Cycle

3—150 KVA Pittsburgh, 6600/220-440 V.
3—100 KVA G. E. 13,200-6600/2200 V.
2— 75 KVA West. 2200/110-220 V.
2— 75 KVA West. 6600/230-460 V.
2—37½ KVA Pittsburgh 2200/220-440 V.

We have other equipment, send us your inquiries

TIPPINS MACHINERY COMPANY

3528 Forbes St. Pittsburgh, Pa.

FOR SALE

200 H.P. McINTOSH-SEYMOUR

Diesel Engine Generator Set, 8 Cylinder, 550 RPM, direct connected to 135 K.W. D.C. Generator 600 Volts.

A. T. METTLER
151 Washington St., Brooklyn, N. Y.
Main 4-3804-5

FOR SALE

1—180 H.P. Allis-Chalmers, Horiz. 2-Cylinder 16" x 24" Full Diesel Direct Connected to 156.5 Kva. 3/60/2300-Volt Generator.
1—280 H. P. De La Vergne, Horiz. 2-Cylinder 20" x 34" Full Diesel Solid Injection, Direct Connected to 250 Kva G-E Generator 3/60/2300 V.
Both have Exciters, and Switch Boards

All Ready for shipment—Kansas City. Write

W. L. Sullivan, P. O. Box 236, Oklahoma City

300 KW ROTARY CONVERTER

1—300 KW Westinghouse Rotary Converter, 600 volts, D.C., 6 phase, 60 cycles, pedestal bearings, 1200 RPM.

SYNCHRONOUS MOTOR

1—250 HP Westinghouse Type HR, for 3/60/2200 volts, 277 RPM, Engine Type

DEEP WELL PUMPS

2—600 GPM, 116 ft. Kingsford Centrifugal Pumps driven by 40 HP General Electric Type CD, 230 V. DC motors.

HOIST

1—50 HP Lidgerwood Double Drum Hoist, 24x24" drums side by side with or without motor, AC or DC.

ELECTRIC EQUIPMENT
FOR
INDUSTRY

LET US KNOW YOUR REQUIREMENTS

REBUILT & GUARANTED STOCK
MOTORS, D.C. & A.C.
TRANSFORMERS
MOTOR GENERATOR SETS
ROTARY CONVERTERS
SWITCHBOARDS BUILT TO ORDER

100 KW ROTARY CONVERTER

1—100 KW General Electric Rotary Converter, Type TCC, 250 volts D.C., 3 phase, 60 cycles, 2300 volts A.C.

CRUSHERS

2—36x48" Link Belt Double Roll Crushers for 1½" to 3" size.

SYNCHRONOUS MOTORS

1—250 HP Westinghouse Type HR, for 3/60/2200 volts, 240 RPM Engine Type.
2—150 HP 80% P.F. Westinghouse Type G for 3/60/220/440 volts, 1200 RPM, direct conn. exciters.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

FOR DETAILS, WRITE **JOHN D. CRAWBUCK CO.** 714-15 EMPIRE BLDG. PITTSBURGH, PENNA.

SEARCHLIGHT SECTION

BOILERS

1—2100 HP Badenhausen 354# pressure with pulverizers and all auxiliaries.
1—1000 HP Badenhausen Riley 200# pressure with pulverizer.
5—512 HP Sterling Class S-26 200# pressure.
1—600 HP Connelly 200# pressure.
1—400 HP Sterling Boiler, 160# pressure with Detroit underfeed stoker.
8—400 HP Sterling 200# pressure with pulverized fuel and all auxiliaries.
1—1040 HP Edge Moor 200# pressure.
2—250 HP Sterling Boilers, 160# pressure equipped with gas burners and controls.
2—253 HP Sterling Boilers, 160# pressure with oil burners.
2—250 HP Wicks vertical Boilers 160# pressure with pulverizers.
1—624 HP Edge Moor Sectional Header, 200# pressure Type E stoker.
3—400 HP Heine Boilers, 160# pressure with chain grate stokers and auxiliaries.
1—685 HP Sterling Boilers 200# pressure with chain grate stoker.
2—500 HP Edge Moor Boilers 200# pressure.
4—500 HP Voigt Water Tube Boilers 175# pressure with chain grate stokers and all auxiliaries.
1—440 HP B & W Sectional Header Boiler 150# pressure, underfeed stoker.
1—522 HP Sterling Boiler 200# pressure with Firite Stoker.
2—484 HP Springfield Boilers 200# pressure.
1—520 HP B&W Sectional Header Boiler, 200# pressure.
1—Complete Power Plant consisting of 2—309 HP Heine Marine Boilers 225# pressure and 2 General Electric Turbines with all auxiliaries.
1—150 HP Scotch Marine 150# pressure.
5—150 HP Erie City HRT Boilers, 125# pressure.
1—300 HP Locomotive Boiler 150# pressure with all trimmings.
1—150,000# Badenhausen Boiler 350# pressure with pulverizer, all auxiliaries.
3—250 HP Erie City vertical boilers with pulverizers.
1—400 HP Connelly Boiler 160# pressure with new tubes and auxiliaries.
2—84" x 20' HRT Boilers, 150# presure all auxiliaries.
6—443 HP B&W Sectional Header Boilers, 200# pressure.
2—150 HP Brownell Boilers, 125# pressure, rebuilt and guaranteed.
56—50 HP Vertical Boilers 150# pressure all auxiliaries.

TURBINES

1—5000 KW Westinghouse 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
1—2500 KW General Electric Condensing Turbine with auxiliaries.
1—2500 KW General Electric Turbine 400# pressure, Surface Condenser.
1—1000 KW Westinghouse non-condensing turbine 350# pressure 16# back pres.
1—937 KVA Allis-Chalmers Turbine.
1—625 KVA General Electric Turbine with jet condenser.
1—2000 KW Westinghouse Turbine with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP Kerr Non-condensing 3600 RPM Turbine.
1—250 KVA Waite Turbine either condensing or non-condensing.
1—250 KVA General Electric non-condensing Turbine.
1—125 KW General Electric non-condensing turbine.
4—250 HP HRT Boilers 150# pressure

ENGINE GENERATOR SETS

1—200 KVA Harrisburg Uniflow Engine Generator Set.
1—750 KVA Rice & Sargent 3-60-600 volt engine generator.
1—480 KW Rice & Sargent 3-60-550 volt engine.
1—375 KVA Chuse Corliss eng. generator.
1—375 KVA Chuse vertical Uniflow engine.
2—312 KVA Skinner Uniflow engines.
1—166 KVA Ames Uniflow engine generator set.
2—125 KVA Skinner Counterflow engine generator sets.

DIESEL ENGINES

1—300 KVA Fairbanks-Morse Full Diesel engine generator set.
1—450 HP Cooper-Bessemer Tex rope driven to 300 KW AC Generator.
1—Complete Gas Engine Plant consisting of 2—375 KVA Sterling and 2—125 KVA Sterling engines.
1—Complete Diesel Plant consisting of 1—250 KVA Buckeye Full Diesel, 1—225 KVA Atlas Full Diesel, 1—94 KVA Caterpillar Diesel.
5—180 HP Fairbanks-Morse Model 35 oil engines.
4—500 HP Busch-Sulzer 6 cylinder oil engines used only 300 hours.

MISCELLANEOUS

2—400 GPM Centrifugal Boiler Feed Pumps.
1—2000 HP Cochrane Metering Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
1—#8 Fuller Bonot Pulverizer.
2—Type AA-6 10 retort Taylor Underfeed Stokers.
2—6 Retort Taylor Underfeed Stokers with fans.
2—6' x 6' Jones underfeed stokers, side dump.
3—72 x 18' HRT Boilers 150# pressure with Detroit underfeed stokers, complete plant.

SEE Fletcher FIRST!

FLETCHER SALES CO.

835 Security Trust Bldg. INDIANAPOLIS, IND.

2 ENGINE-GENERATOR SETS
1 TURBO-GENERATOR SET

125 K.W. Crocker Wheeler Generator, D.C., 200 R.P.M. Type CCD connected to Ball Engine Co., Erie, Penna. Engine.

750 K.W. Crocker Wheeler Generator, 250V, 720 RPM, 168 DA Frame connected to Terry Steam Turbine, new 1925, 150 lb. press, 500° F. with Worthington Surface condenser and ejector—condensing.

150 K.W. Hill McAnna Co. Generator, 225 RPM connected to Ridgeway Engine Size H, 100 lb. press.

For further information write or Wire

CONSOLIDATED MANAGEMENT CORP.

444-4th AVE. **NEW YORK CITY, N. Y.**

Tel. MUrray Hill 5-0311

POWER EQUIPMENT FOR PROMPT SHIPMENT

SQUIRREL CAGE MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
700	G.E.	6600	1800	
150	West.	220/440	580	CCL
125/40	Cr. Wh.	2200	700	125AQ
125	Burke	220/440	1200	
125	Cr. Wh.	2200	700	125AQ
100	Al. Ch.	2200	900	

HP	Make	Type	Speed
2	R & M	122	1000
5	R & M	125	1000
15	West.		650
25	Shaw		600
50	Shaw		600
100	G.E.	MD 105	480
130	G.E.	CO 1812	550
175	G.E.	MDS 1901¼	475

DC SERIES & CPD. MOTORS

HP	Make	Type	Speed
200	Allis	Interpole	600

SYN. MOTORS, 3 ph. 60 cy.

HP	Make	Volts	Speed
75 (2)	G.E. ATI	2200	900

SLIP RING MOTORS, (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
1000	Al. Ch.	440	235	
700	G.E.	2200	393	MT 432
300	G.E.	440	600	I-M
200	G.E.	2200	240	MT 412
150	G.E.	220/440	720	I-M
150	G.E.	220	575	I-M
125	Al. Ch.	2200	435	
100	Al. Ch.	220/440	575	
100	G.E.-25 cy.	220/440	500	MI-108

"Wound Rotor Motors" (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
200	G.E.	2200	600	I-L
150	G.E.	2200	600	I-L

TRANSFORMERS

Qu.	KVA	Make	Voltage
3	37	West.	4400/185
3	50	G.E.	22000/2200
3	75	G.E.	2300/110/220
3	100	Uptegraff	440/220
1	150	G.E. (3 ph)	2080/230/460

OIL ENGINE DRIVE AIR COMPRESSOR

Chicago Pneumatic simplate valve type, NS03 straight line 16½ & 11 x 18" capacity 492 cu. ft. displacement, 100# pressure, with air receiver and starting air compressor.

M-G SETS 3 ph. 60 cy. (Syn.)

2—150 KW G.E. Type HCC 6 Rotary Con. 250 v. DC 2200 or 4000 v. AC
150 KW West. 550 v. DC—2200 AC 1200 RPM
150 KW Ridg. 250 v. DC—2300/3/60 AC
100 KW G. E. 550 v. DC—2200 v. 900 RPM
90 KW Al. Chal. 230 v. DC 2200 v. AC 900 RPM

SHOP HOISTS

1—1 Ton Sprague 230 v. DC
2—2 Ton Sprague 230/500 v. DC Monorail

In addition to the above, we have hundreds of other items in stock—kindly send us your inquiries.

MOORHEAD-REITMEYER CO., INC.

Pittsburgh, Pennsylvania

IF YOU DON'T KNOW MACHINERY—KNOW YOUR MACHINERY DEALER

NEED ANYTHING?

180 HP Fairbanks "VA" Diesel Engine.
Clutch Pulley for 360 HP Diesel Engine.
2—250 HP Heine Watertube Boilers 150#.
100 HP 100# Kewanee #419 Firebox Boiler.
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1500 CFM 2 STAGE AIR COMP. 275 HP. SYN. MOTOR DRIVE.
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1500 KW-Non Cond. Turbo Generator Unit 3600 RPM
5000 KW otherwise as above, except 2300/4000
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1500 " " " " Jet Cond.
1250 " " " " Jet Cond. — 1—2000 KW.
1000 " " " " Surface Cond. — 2—1000 KW.
750 " " " " Surface Cond.
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Boilers 4—1000 HP., 4—750 HP., 2—500 HP., 4—560 HP.

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Citizens Gas and Coke Utility,
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1—520 HP HAMILTON CORLISS ENGINE GENERATOR SET, DIRECT CONNECTED TO G. E. 360 KW GENERATOR, 3/60/480 VOLT, 150 RPM, WITH G. E. EXCITER AND WESTINGHOUSE 3 PANEL SWITCHBOARD.

Several Boilers, from 100 to 500 HP, with and without Stokers.

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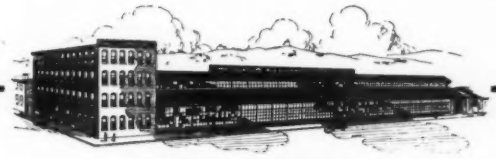

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1—150 KW 250 V. G. E. (W-E) d. c. to 16"x20" Ball, 4 valve, 200 RPM
1—150 KW 125 V. Triumph d. c. to 14"x36" Rice & Sargent, 4 valve, 150 RPM
1—200 KW 125 V. Triumph d. c. to 16"x36" Rice & Sargent, 4 valve, 150 RPM
1—200 KW 125 V. G. E. d. c. to 15 & 25"x20" Tandem Compound Skinner, 210 RPM
1—200 KW 250 V. G. E. d. c. to 18"x24" Chuse Corliss, 200 RPM
1—300 KW 125 V. Triumph d. c. to 22"x36" Rice & Sargent, 4 valve, 125 RPM
2—300 KW 250 V. Elliott d. c. to 21"x28" Elliott, 4 valve, 165 RPM
1—150 KW 2300 V. 3 ph. G. E. d. c. to 14"x36" Rice & Sargent, 4 valve, 164 RPM
1—150 KW 240 V. 3 ph. G. E. d. c. to 16"x18" Erie Ball, 4 valve, 225 RPM
1—200 KW 480 V. 3 ph. G. E. d. c. to 16"x36" Rice & Sargent, 4 valve, 164 RPM
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3 phase, 60 cycles, 220 volts, 600 R.P.M

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WE ARE READY TO PURCHASE

15 KW, 25 KW, 50 KW, 100 KW, 150 KW — MOTOR GENERATOR SETS 125 OR 250 VOLTS

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A.C. and D.C. Control Equipment
Alternators, 900 and 1200 R.P.M.
All Types of Belted Generators

WE HAVE AVAILABLE IN STOCK

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200 H.P. G.E. TS 514 RPM
SLIPRING MOTORS
500 H.P. A-C—1200 RPM
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250 H.P. G.E., 600 RPM
200 H.P. G.E., 720 RPM
200 H.P. G.E., 514 RPM
125 H.P. Burke, 600 RPM
75 H.P. West., 1200 RPM (5)
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60 H.P. West., 290 RPM
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100 H.P. Cr.-Wh. 1800 RPM
100 H.P. West., 720 RPM (4)
100 H.P. G.E., 720 RPM (2)
100 H.P. G.E., 600 RPM
75 H.P. West., 1800 RPM
60 H.P. G.E., 1800 RPM
50 H.P. Allis Ch., 720 RPM
50 H.P. G.E., 720 RPM
50 H.P. G.E., 600 RPM
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125 KW Curtis, steam turbine
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50 KW Star, 1150 RPM
50 KW West., 850 RPM
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100 H.P. Reliance, 1150 RPM
85 H.P. G.E., 880 RPM
60 H.P. G.E., 1050 RPM
60 H.P. G.E., 900 RPM
60 H.P. Roth, 600 RPM
50 H.P. G.E., 850 RPM
40 H.P. El. Dyn., 1450/2600
40 H.P. G.E., 1700 RPM
40 H.P. Allis Ch., 1150 RPM
40 H.P. Reliance, 625 RPM
25 H.P. G.E., 1150 RPM (3)
25 H.P. West., 850 RPM (2)
25 H.P. G.E., 575 RPM
20 H.P. G.E., 1750 RPM (2)
(235 additional motors, ½ to 20 H.P. in stock)
115 VOLT D.C. MOTORS
90 H.P. G.E., 900 RPM
15 H.P. G.E., 1150 RPM
10 H.P. L.A., 3600 RPM
10 H.P. F.-M., 1150 RPM
10 H.P. West., 850 RPM
7½ H.P. G.E., 1750 RPM
7½ H.P. West., 1150 RPM
7½ H.P. G.E., 850 RPM
(115 additional 115 volt D.C. Motors, ½ to 5 H.P., also in stock)

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New York City's largest stock Electrical Equipment
ONE YEAR GUARANTEE
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POWER PLANT, with 2, 300 H.P. Boilers complete with 2, 500 KW, 3/60/2300 Turbines and Generators.
2—300 H.P. Water Tube Boilers
1—453 H.P. 160# Stirling W. T. Boiler
1—500 H.P. 150# Scotch Marine Boiler, twin fire boxes

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327 C.F.M. Ingersoll-Rand 2-stage Imperial Type 10, belt drive
1750 C.F.M. I-R with 300 H.P. motor
1050 C.F.M. Chi. Pneu. Type OCB with 150 H.P. A.C. motor

ELECTRIC MOTORS

30 Units 15 to 75 H.P., squirrel cage, 3/60/440 A.C.
15 Units 3 H.P. to 60 H.P., 230 V D.C.
We also have on hand miscellaneous electrical items such as: Oil Switches, Oil Circuit Breakers, Lighting Generators, Compensators.
(Write for our Electrical List)

GENERATORS

3½ KW F-M Generator, Type CP, shunt wound, 2000 RPM, 20 amps. Frame 5
40 KW G.E. Type MP 110 V. D.C., belt drive, 860 RPM, 360 amps.
200 KW West. #201 SK, comp. wound, 600 V. D.C. with 290 H.P. syn. motor, 3/60/2200, 900 RPM
300 H.P. Buckeye Diesel Engine & Gen. 3/60/240.
500 KW G.E. Skinner Uniflow Steam Eng. Gen., 250 V. D.C.
100 KW G.E. Type ATB-2-1250-3600 Form T, 814 amps, 3/60/2200-900 RPM
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POWER PLANT—Complete with two 625 KW Turbo Generators 3/60/2300, complete with 309 H.P. each Heine Water Tube Boilers, 225# steam pressure

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Superior Iron Works single drum, 36" dia., with 80 H.P. G.E. type MTC motor
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1—250 HP Fairbanks-Morse, slip ring motor, 600 RPM, 3 ph. 60 cys. 440 volts, with secondary drum controller, resistance and panel board, with oil switch, type BV.

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2—Lecourtenay horizontal split case 4000 GPM against 170' hd., 1750 RPM centrifugal pumps each direct con. to 200 HP 3/60/208 vt. induction motors mounted on common cast iron base—used but little—excellent condition—attractive price for immediate shipment.

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Robert Berryman Feed Water Heater for use with 450 H.P. boiler, dimensions 12 ft. long, 30" diameter, steam connection for 8" pipe, water connections for 2" pipe. Manufactured by I. B. Davis & Son, Hartford, Conn.

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Will sell subject government regulations and prior sale about March 1, 1943—3 Skinner Unaflow Engines with Westinghouse generators and exciters rated 1000—375—62½ KVA, all 440V—60 C 3 Ph. Also include 2 HRT Nu-Way Boilers rated 255 BHP each with Whiting Stokers, etc. Plant operating open for inspection. Sell as entire unit only.

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Large selection—All sizes and types. Generator units, marine engines, gasoline engines, auxiliaries—also boilers, steam engines, turbo generators.

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Used 75 K.W. BUCKEYE piston type valve direct connected engine and exciter, two wire direct current generator 230 volts.

1—10 x 30 BELT DRIVEN ALLIS-CORLISS ENGINE

1—12 x 36 BELT DRIVEN ALLIS-CORLISS ENGINE

Immediate Delivery. Subject to prior sale. All Used Equipment. In Good Operating Condition.

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With two 516 H.P. Stirling Boilers, two 500 KVA turbine driven Generators with barometric condensers, Cookson water heaters, super heaters, chain grate stokers, and all necessary piping. Also steam driven compressors, steam driven hoist, approximately 20,000 feet of 1½" and 1¼" cable. Also seven 250 H.P. 120# working pressure Firebox Boilers and a number of HRT Boilers.

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3—833 KVA, G.E. Transformers
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1—2500 KW G.E. 2300 V. Cond.
1— 625 KW Terry-Allis—600 V. Cond.
1— 500 KW G.E. 240 V. Cond.
1— 500 KW G.E. 2300 V. Mixed P.
1— 500 KW G.E. 600 V. Cond.
1— 175 H.P. G.E. Turbine—only.

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1— 146—Cu. Ft.—IR—3 stage Belted. 1200#.

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1—500 KW. G.E. 550 V. 225—RPM.

G.E. CENTRIFUGAL COMPRESSOR

Type WM—675—8800/10800.
Volume—8800/10800 Pressure 32/39.6.
Driven by 820 H.P. G.E. Turbine.
Condition excellent.

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1—126,000 CFM to 210 HP Turbines.
1—165,000 CFM to 450 HP Turbine.

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250 VOLT ROTARY CONVERTERS

1—1500 KW. Westinghouse compound interpole 250 V. D.C., 6 phase, 60 cycle AC Rotary converter, 600 RPM.
3 Single phase, 2300 Volt Transformers 1—DC and 1—AC panel for above.

2—1000 KW., Westinghouse compound interpole 250 volt DC, 6 phase, 60 Cycle AC Rotary Converter 900 RPM.
2—Banks of 3 Single phase, 2300 volt transformers for above and 2—DC and 2—AC panels.

The above in excellent condition.

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1—400 amp. DC welding M-G set, 440-3-60 supply voltage.
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One 100 K. W. 250 volt D. C. **Turbo Generator Turbine-Curtis** Form C, 2 stage 3600 R.P.M. 150# S.W.P.
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Worthington, horizontal, three-stage, steam-driven. Formerly used for CO_2.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators new or used.

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1—100 HP ASME 125# P. H.R.T.
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2—357 HP 175# P. W. T.
2—500 HP 200# P. W. T.
1—50,000 Gal. Tank & Tower.

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1—3500 KW. G.E. Synchronous Booster type 250/310 volts D.C.

BOILERS and STOKERS

6—400, 500, 600 and 750 HP. Taylor Retort Stokers.

3—520 HP. B & W Superheaters and Stokers.

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24—Stokers from 400 up to 1000 hp. each. Ready for immediate delivery.

We specialize in high pressure boiler fittings, Boiler-Supports Superheaters pop safety valves, blow-off valves, steel headers, steam valves up to 600 lbs. up to 24" in diameter, turbine and motor driven boiler feed boilers—high and low pressure pumps.

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Stock of 5,000 current and potential transformers of all sizes, all kinds of relays, overload, underload, heat element, etc.

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1250 KW TURBO-GEN.

Westinghouse—1250 KW condensing bleeder. St. Pressure 150# T. T. 500° 3600 rpm. Bleeding Pr. 15# Complete with jet condenser and instruments. 3 phase 60 cycle 480 volt.

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2 Allis-Chalmers Pump Units

3000 g.p.m., 65' head, 1155 r.p.m. 60 hp. Induction Motors, 220 Volts

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(NEW OR USED)

ONE WEEK'S DELIVERY AFTER RECEIPT OF ORDER

Sizes from 50 H.P. to 125 H.P., 50# W.P. to 350# W.P., Oil, Gas or Coal Fired, Shaker Grates or Stokers, Hartford or Oklahoma approved Certificate.

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250 KW 125 V. 320 RPM with 4 CYL. 11 x 12 VERTICAL Uniflow engine.
NEW 400 H.P. 4 CYL. 11 x 10 VERTICAL Uniflow engine.
2—566 H.P. B. & W. 200# Code straight tube coal fired boilers.
75 KW D.C. Gasoline engine set, factory job.
75 KW 125 V. Syn. Motor Generator set, also 250 V. set same size.
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This is possible because of an ingenious power seal in *Airetool Motors* that gives valuable extra power. Starts under heavy loads. Constant torque at low speeds prevents stalling.

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Write for Bulletin P-15

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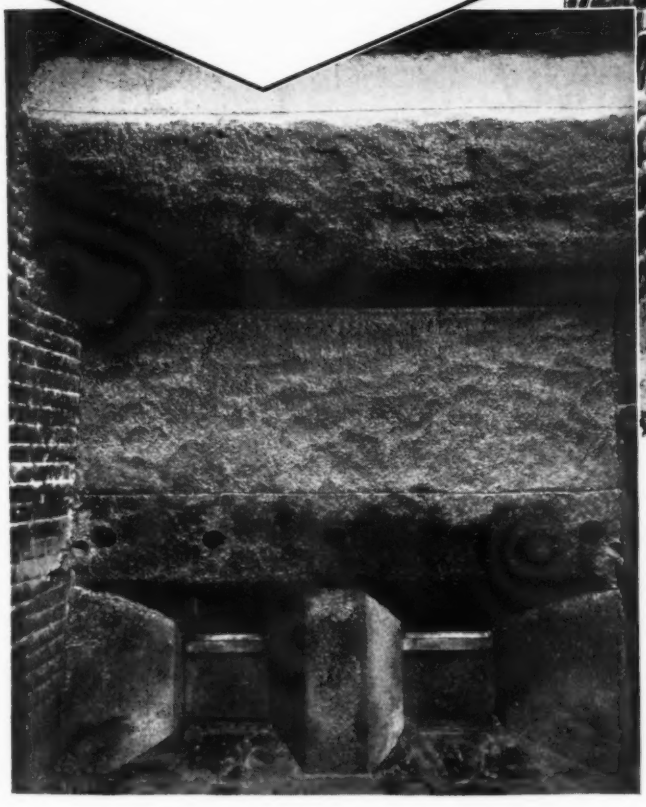
Not with PLIBRICO



Monolithic Plibrico front wall and suspended arches in connection with 300 hp. water tube boiler equipped with Firite spreader-type stoker.

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HOW them Gremlins do get around! You can't always see them as clearly as this. But it isn't very difficult to find the results of their pesky work.

That photo above is a good example. Note how the joints have been opened . . . how the suspended arch is ready to collapse . . . how the center pier is cracked.

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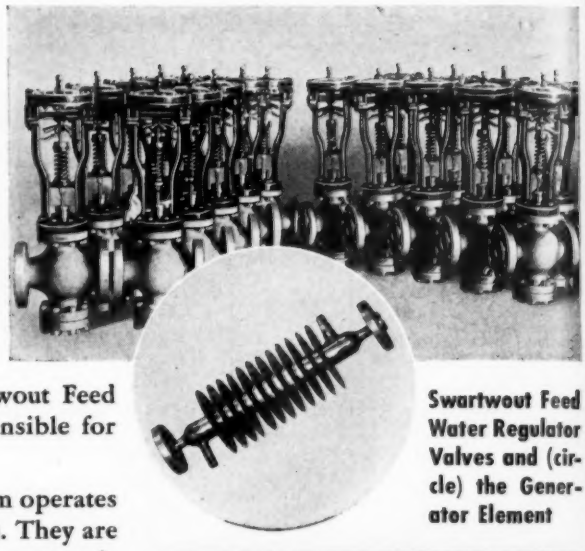
on land or on sea for these and many more

Swartwout Feed Water Regulators

...But this rugged, sensitive equipment can *take it*... saves manpower... puts your boiler feeding on a thoroughly dependable basis

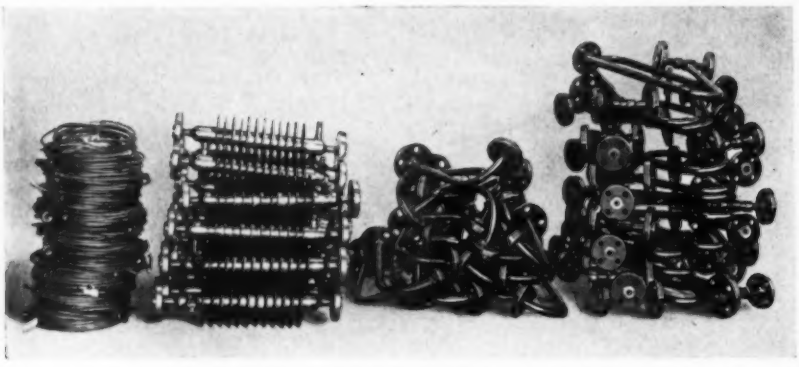


Swartwout Feed Water Regulator Valves and (circle) the Generator Element

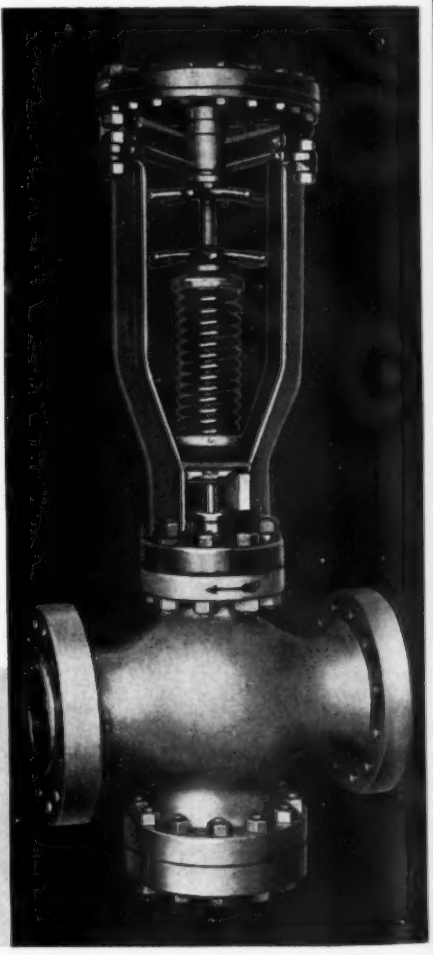
RECOGNITION of the consistent performance of Swartwout Feed Water Regulators under most severe conditions is responsible for their use in hundreds of critical power plants.

The thermo-hydraulic principle on which the Swartwout System operates permits wide leeway in the location of the two major elements. They are connected through a single line of flexible tubing. Completely automatic regulation, requires little attention from operators, and practically no maintenance. It is easily installed, readily adjusted to varying conditions. One of the most widely used products of this 38-year-old concern. Write for Bulletin S-20-D.

THE SWARTWOUT COMPANY • 18501 Euclid Avenue, Cleveland, Ohio



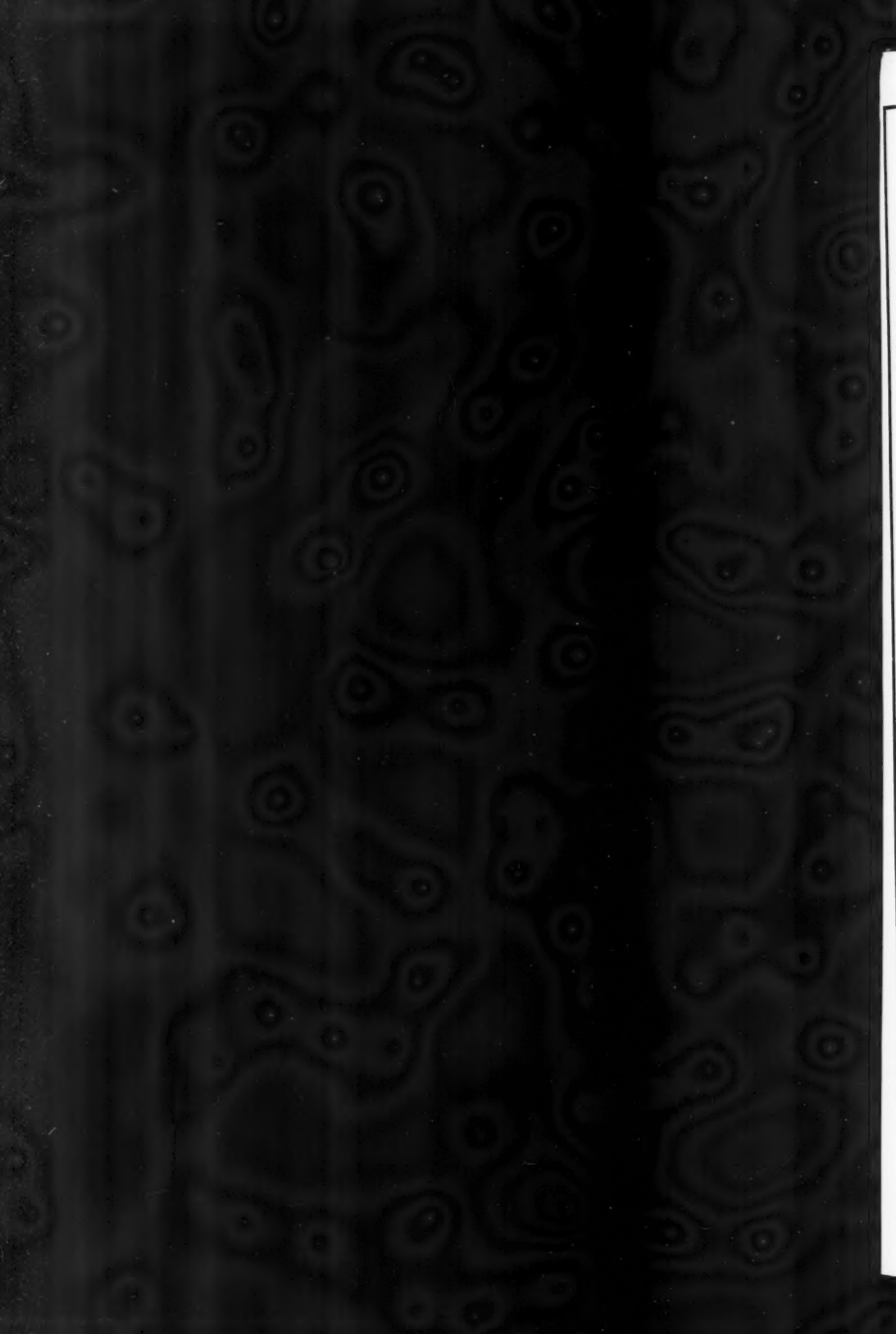
Generators, fitted piping and flexible tubing ready for shipment.



Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

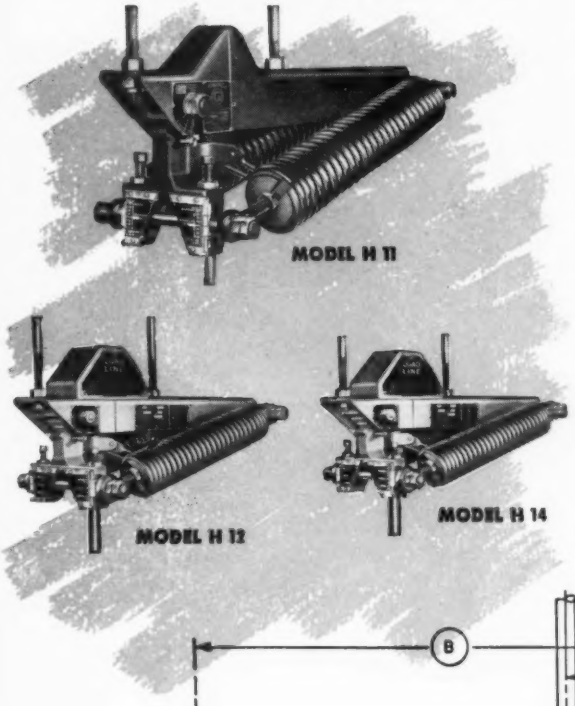
Swartwout

•Power Plant Equipment•



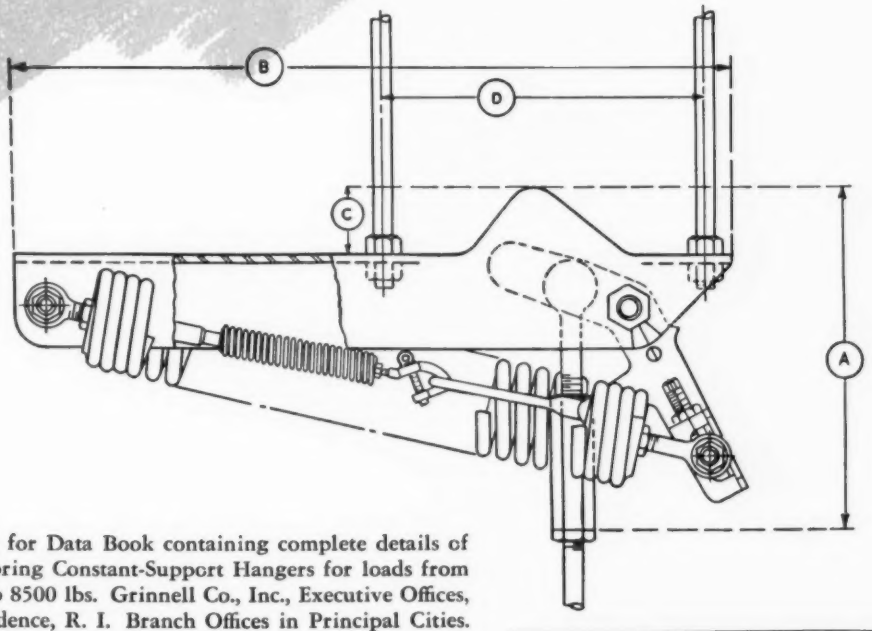
Genspring Hangers require

MINIMUM HEAD ROOM!



Only Genspring Hangers offer these highly important features for power piping suspension:

- **. . . constant-support of piping in all "hot" and "cold" positions.**
- **. . . full safety factor of the supported system is always maintained.**
- **. . . mass produced from standard precision parts.**
- **. . . individually calibrated for each specific installation.**
- **. . . the rated capacity of each model varies with the size of the springs used – the overall dimensions of the hanger remain constant.**
- **. . . minimum head room – see measurements as evidence of small amount of head room required.**



Write for Data Book containing complete details of Genspring Constant-Support Hangers for loads from 250 to 8500 lbs. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch Offices in Principal Cities.

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MODEL H 14	$10\frac{13}{16}$	19	$3\frac{3}{16}$	$9\frac{5}{32}$
MODEL H 12	$13\frac{3}{8}$	$28\frac{1}{4}$	3	12
MODEL H 11	$20\frac{1}{16}$	$34\frac{3}{4}$	$3\frac{3}{16}$	$15\frac{1}{8}$

GENSPRING **CONSTANT-SUPPORT HANGERS BY**

GRINNELL

WHENEVER PIPING IS INVOLVED

Cradle of Conflict

Painting by Harold M. Kramer

THIS is a typical winter scene in a pre-war German farm home. You would hardly guess that it is a picture of poison in the economic bloodstream of civilization. But that is exactly what it is . . . for here is a view of one of the things America is fighting to avoid.

Possibly you did not know that German farmers after the harvest each Fall carried home from nearby factories baskets of semi-manufactured parts for the entire family to work on throughout the winter. And it may even seem that it was not *your* concern that these people so far away labored thus for less than 2¢ an hour.

But it was *your* concern and it still is . . . for 2¢ an hour are *slave* wages . . . and it is now very clear that the world can never live in peace half slave and half free. Either the oppressed must be raised to a decent level of living or we must sink to theirs. The wonders of the "American Way" of making things by machine to get low costs *without* low wages must be victorious *now* or Hitler's substitute is the pattern for *your* future and your *children's* future for generations to come. Cutler-Hammer, Inc., *Pioneer Electrical Manufacturers*, 1358 St. Paul Avenue, Milwaukee, Wisconsin.

One of a series of advertisements dedicated to a fuller appreciation of the stake each American has in victory

CUTLER-HAMMER
MOTOR CONTROL
C-H

REPRINTS OF THIS ADVERTISEMENT FOR BULLETIN BOARDS ON REQUEST